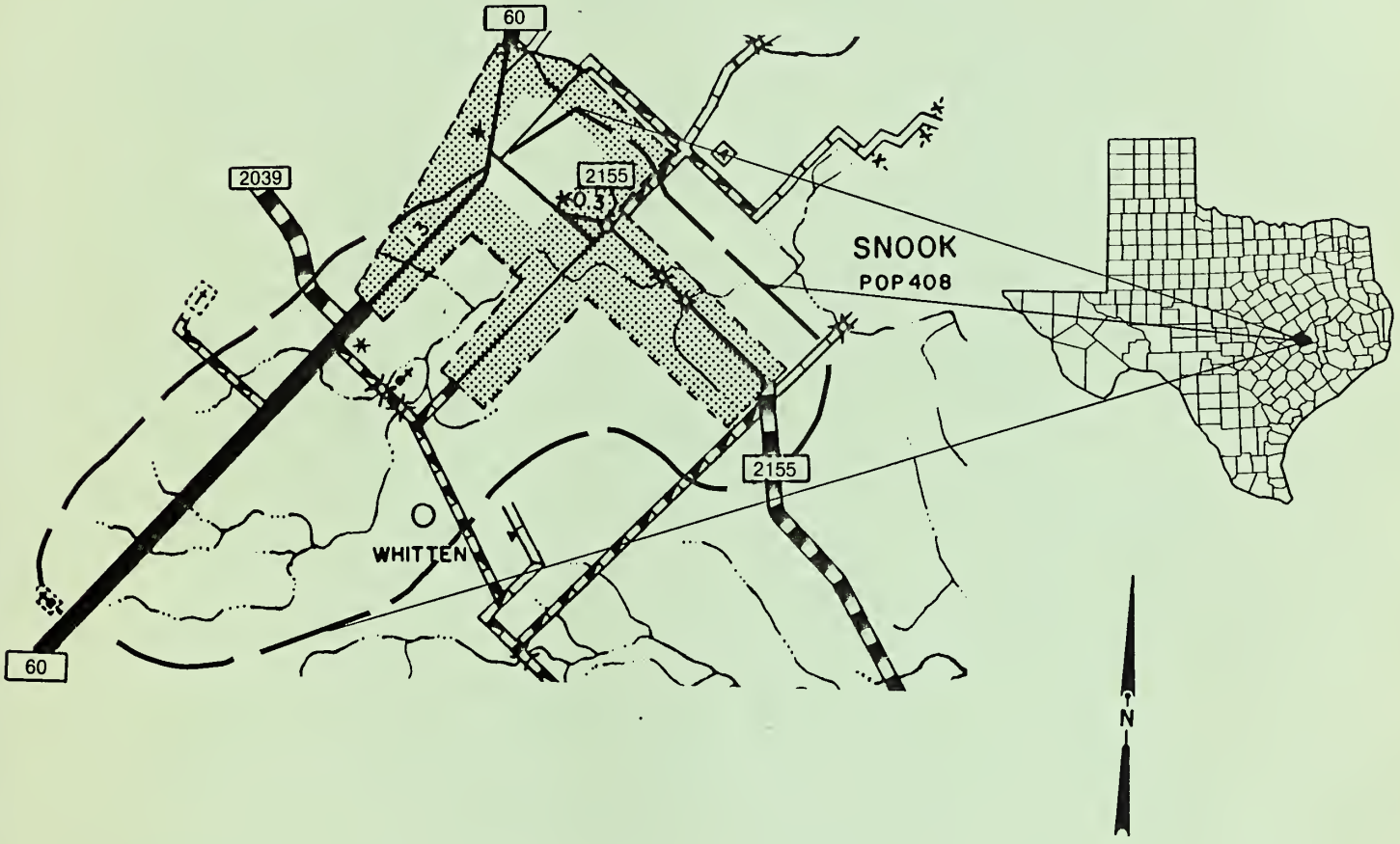
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS



Prepared by
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Temple, Texas

In cooperation with
BURLESON-LEE SOIL AND WATER CONSERVATION DISTRICT
BURLESON COUNTY COMMISSIONERS COURT
CITY OF SNOOK
and the
TEXAS WATER COMMISSION

APRIL 1986

FLOOD PLAIN MANAGEMENT STUDY

CITY OF SNOOK,

BURLESON COUNTY, TEXAS

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UNITED STATES DEPARTMENT OF AGRICULTURE
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101 South Main
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TABLE OF CONTENTS

	Page
INTRODUCTION	1
DESCRIPTION OF STUDY AREA	3
NATURAL VALUES	5
Prime Farmland Soils	7
Fish and Wildlife Habitat	8
Threatened and Endangered Species	8
Wetlands	9
FLOOD PROBLEMS	9
EXISTING FLOOD PLAIN MANAGEMENT	10
ALTERNATIVES FOR FLOOD PLAIN MANAGEMENT	13
Present Conditions	13
Land Treatment	14
Preservation and Restoration of Natural Values	14
Nonstructural Measures	14
Structural Measures	18
Selected Alternative	18
FLOOD HAZARD MAPS	18
TECHNICAL APPENDIX	19
GLOSSARY	22
BIBLIOGRAPHY	25

INTRODUCTION

This flood plain management study report identifies areas of flood plain subject to flooding by Old River Tributary 1, Old River Tributary 2, and Old River Tributary 3 within the City of Snook and vicinity, Burleson County, Texas.

The assistance and cooperation given by the agencies, organizations and individuals during the City of Snook Flood Plain Management Study is greatly appreciated. These include:

-- Burleson-Lee Soil and Water Conservation District
-- City of Snook
-- Burleson County Commissioners Court

Special appreciation is extended to the individuals who contributed information for the study. Appreciation is also extended to the landowners who permitted access to their property for surveys, photographs, and reconnaissance.

It was estimated that 80 residences, 20 businesses, and 6 public buildings including the Snook public school complex are located in areas subject to flooding. Minor or nuisance type flooding occurs several times each year. Severe floods causing extensive damages occurred in 1921, 1947, 1965, 1969, and in March 1983 and again in May 1983.

Since Snook is within 10 miles of the Bryan-College Station Area, Snook is growing and is expected to experience rapid development as a residential area.

The City of Snook is not in the federal flood insurance program and no detailed flood insurance study has been made.

This cooperative study was requested by the City of Snook, the Burleson-Lee Soil and Water Conservation District, Burleson County Commissioners Court, and the Texas Water Commission in order to obtain a factual basis for reducing future flood damages and flood hazards through carefully considered and well planned local regulations and use of the flood plain.

The study was conducted according to the December 1983 Plan of Work developed and endorsed by the above named requesting entities and the Soil Conservation Service (SCS).

The SCS conducts cooperative flood plain management studies in Texas through the November 1973 Joint Coordination Agreement (Revised 10/30/78) between the SCS and the Texas Department of Water Resources [1/]. SCS assists state agencies and communities in the development, revision, and implementation of their flood plain management programs by carrying out cooperative flood plain management studies (FPMS's) in accordance with Federal Level Recommendation 3 of "A Unified National Program for Flood Plain Management," and Section 6 of Public Law 83-566. The principles

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1/ Changed to Texas Water Commission in 1985 by the 69th Texas Legislature.

contained in Executive Order 11988, Flood Plain Management, are addressed in this part.

Topographic data for this study were obtained from field surveys and Geological Survey topographic maps. Rainfall frequency data were obtained from Weather Bureau Technical Paper No. 40, Rainfall Frequency Atlas of the United States. Peak discharge values were obtained using U.S. Geological Survey Water Resources Investigations 77-110 Open File Report, "Technique for Estimating the Magnitude and Frequency of Floods in Texas." Water surface profiles were developed by the Modified Slope Area Method using SCS Technical Release No. 61, WSP2, A Computer Program for Determining Flood Elevations and Flood Areas for Certain Flow Rates.

DESCRIPTION OF STUDY AREA

The study area includes three unnamed tributaries to Old River. Old River drains into the Brazos River. The unnamed tributaries are designated Old River Tributaries 1, 2, and 3 in this study. The study area is in Geological Survey Hydrologic Unit Number 12070101. The study area watershed is in the Water Resources Council Texas-Gulf Region, Subregion 07, and Brazos River Basin.

Old River Tributary 1 heads approximately 3 miles southwest of the Snook city limits. It runs through the City of Snook in an easterly direction toward the Old River tributary of the Brazos River. Old River Tributary

2 heads 0.3 mile southeast of the Snook city limits and travels in a northwesterly direction to its confluence with Old River Tributary 1. Old River Tributary 3 heads near the north central city limits of Snook and travels through the City of Snook in a southeasterly direction to its confluence with Old River Tributary 1.

The Study limit terminates near the southeast corner of Snook city limits. The total drainage area of the study area is 6.25 square miles or 4,000 acres.

The City of Snook is the only community located within the study area. The 1980 census gives the population of Snook as 408.

The Index and Study Area Map, Appendix, page 6, shows the streams and areas that were studied. The total channel length of stream reaches that were studied in detail is 4.1 miles. This includes Old River Tributary 1, 2.8 miles; Old River Tributary 2, 0.6 mile; and Old River Tributary 3, 0.7 mile.

The study area watershed has a moist subhumid climate with moderate temperatures. The winters are mild with a January average minimum temperature of 38 degrees Fahrenheit. The July average maximum temperature is 94 degrees Fahrenheit. The mean annual rainfall is 37.45 inches with an irregular seasonal distribution. The average growing season is 275 days.

The soils are of the Texas Blackland Prairie Land Resource Area. They have loamy surface layers over clayey subsoils.

NATURAL VALUES

This study area is located in the Blackland Prairie and Post Oak Savannah Vegetational areas as described by F. W. Gould in Texas Plants -- A Checklist and Ecological Summary.

The Blackland Prairie covers over 95 percent of the study area. It is classified as a true prairie and historically the dominant vegetation was mid and tall grasses with woody vegetation restricted to the major drainage ways.

The Post Oak Savannah in its climax condition consisted of mid and tall grasses with scattered woody vegetation. The woody vegetation covered 15-20 percent of the ground with grasses dominating the remaining areas. Major woody species included post oak, blackjack oak, elm and hackberry. Little bluestem, Indiangrass, and brownseed paspalum made up 60 percent of the grasses. Other grasses, forbs, legumes, woody shrubs and vines were also present.

Much of the vegetation has changed from its climax condition. Most of it has been converted to pastureland or cropland. The rest has been overgrazed which has caused less desirable species to invade the area. Common invaders include annual grasses and forbs and woody species such as mesquite.

Present land use is shown in the following table.

TABLE 1

PRESENT LAND USE

CITY OF SNOOK WATERSHED

Land Use	Acres	Percent of Study Area
Cropland	1499	37
Pastureland/Rangeland	988	25
Wooded Rangeland	1181	29
Water	16	1
Urban	316	8
Total	4000	100

Cropland comprises 37 percent of the study area. Major crops being grown are small grain and some cotton.

Twenty-five percent of the area is pastureland/rangeland. Coastal bermuda is the dominant pasture grass. Major grasses on rangeland include species of bluestem, lovegrass, panicum, paspalums and annual grasses and forbs.

Wooded rangeland covers 29 percent of the watershed. It includes woody species in the upland and along the stream courses. Principal species in the study area include hackberry, elm, mesquite, and various species of oaks. Understory species include yaupon, hawthorns, greenbriar and

many species of forbs, vines and grasses. Mesquite and huisache are common invaders in the area. Mesquite is presently found on approximately 700 acres.

The major and most important natural value of the study area flood plain is its ability to transport floodwater.

PRIME FARMLAND SOILS

The general soil survey for Burleson County shows three soil associations occur within the study area. These are Burleson-Wilson, Falba-Burlewash and Ships-Westwood.

The Burleson-Wilson covers 95 percent of the study area. These soils are nearly level to gently sloping, deep clayey soils.

Falba-Burlewash Association covers three percent of the watershed. It occurs as upland soils nearly level to gently sloping moderately deep loamy soils.

The remaining two percent is Ships-Westwood Association, which is bottom land soils. These soils are nearly level, deep loamy to clayey.

Prime farmland soils do occur in the study area. These soils are Burleson (1-3 percent slope), Ships (0-3 percent) and Westwood (0-3 percent slope).

FISH AND WILDLIFE HABITAT

The fishery resource in the study area is restricted to farm ponds, since the streams have ephemeral flow. The principal species of fish in these impoundments are largemouth bass, channel catfish, bullhead catfish and various species of sunfish.

The wildlife resources in the watershed are associated with woody vegetation in the upper part of the watershed, broad open areas of cropland and pastureland/rangeland in the rest of the watershed with small riparian woodlands traversing through these open areas.

The principal game species occurring in the watershed are mourning dove and bobwhite quail. Some white-tailed deer are found in the watershed, but limited in number because of the lack of sufficient cover. Waterfowl and shorebirds also occur in the watershed on farm ponds in limited numbers.

Predator species include coyotes, bobcat and various species of raptors. The principal furbearers in this area are raccoon, opossum, skunk, gray fox, red fox, mink and beaver. Other species in the watershed are cottontail, swamp rabbit, jackrabbit and large variety of songbirds and rodents.

THREATENED AND ENDANGERED SPECIES

This watershed is in the range of occurrence of possibly two species, which have been designated by the U.S. Fish and Wildlife Service as being endangered and one species as threatened. The endangered species are whooping crane (Grus americana) and Artic peregrine falcon (Falco

peregrinus tundrus). Both of these are migratory and may migrate through this area. The American alligator, presently classified as threatened, may inhabit the study area.

WETLANDS

The wetland in the study area watershed is Type 5 (inland open fresh water), as defined by the U.S. Fish and Wildlife Service Circular 39. The Type 5 wetland in this watershed amounts to five acres and consists of farm ponds which are ten feet or less in depth and are bordered by emergent aquatic vegetation.

FLOOD PROBLEMS

Floods from Old River Tributary 1, Old River Tributary 2, and Old River Tributary 3 damage residences, businesses, other buildings, streets and highways in the City of Snook. Approximately 28 buildings would be affected by the 500-year frequency flood. These 28 buildings with contents have an estimated value of $635,000. Approximately 19 buildings would be affected by the 100-year flood. These 19 buildings with contents have an estimated value of $297,100.

In addition to the areas affected by overbank flooding from the streams studied, other areas are affected by minor or niusance type flooding caused by trapped local runoff water due to poor surface drainage.

Potential flood heights for 100-year and 500-year floods photographed at various locations to illustrate the flood problems are shown on page 10 Figures 1 and 2.

Following is a tabulation of the acreages of rural and urban areas subject to inundation by the 100-year and 500-year floods.

FLOODED AREAS
CITY OF SNOOK WATERSHED

	Rural (Acres)	Urban (Acres)	Total (Acres)
Within the 100-year frequency flood plain	245	23	268
Within the 500-year frequency flood plain	276	39	315

Upstream flood plain and watershed land use changes anticipated by local officials within the next 10 to 15 years are not expected to significantly affect future flood elevations on the flood plains of the study area.

EXISTING FLOOD PLAIN MANAGEMENT

The 61st Texas Legislature in 1969 enacted the Texas Flood Control and Insurance Act, Article 8280-13 VACS, and Article 1581e-1 VACS. Article 8280-13 named the Texas Water Development Board and the State Board of Insurance as the responsible state-level agencies in respect to the National Flood Insurance Program. In 1985, the 69th Texas Legislature created the Texas Water Development Board and the Texas Water Commission from the Texas Department of Water Resources. Article 8280-13 was codified in Texas Water Code (Subchapter I, Section 16.311), and responsibility for the flood insurance program in Texas was assigned to

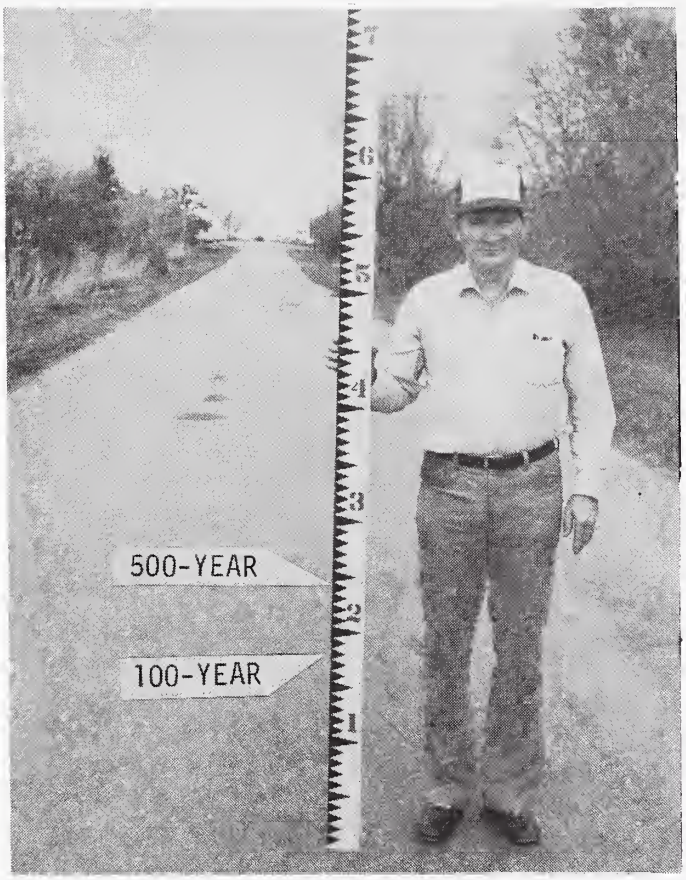
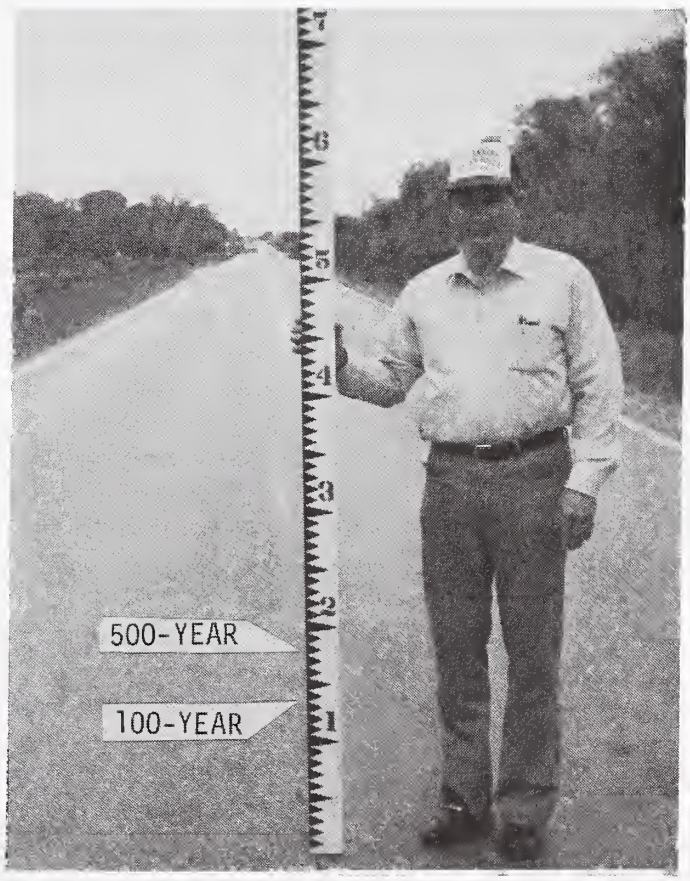


FIGURE 1 -- Potential flood heights at Cross Section 7, Station 6160, on County Road 269, approximately 284 feet east of bridge on Old River Tributary 1.

FIGURE 2 -- Potential flood heights at Cross Section 3, Station 380, Old River Tributary 2, approximately 414 feet north of culvert where County Road 2155 crosses Old River Tributary 2.



the Texas Water Commission and the State Board of Insurance. Subchapter I, Section 16.315 of the Code authorizes all political subdivisions, including cities, counties, and many types of special purpose districts and authorities, to take all necessary and reasonable actions to comply with the requirements and criteria of the National Flood Insurance Program.

At the present time, state-level statutory controls on use and management of flood hazard areas are fairly limited. Subchapter G, Section 16.236 of the Texas Water Code requires the Texas Water Commission or the local political entity to approve plans for any levee or other such improvement which may change floodflows of any stream in Texas that is subject to floods. Also, in December 1977, Governor Briscoe issued Executive Order No. 34-A calling for state agencies to implement a flood plain management program for state-owned property and facilities. This state program will utilize state agency rules and regulations calling for evaluation of flood hazards and will conform to the minimum flood plain management criteria established by the U. S. Department of Housing and Urban Development for the National Flood Insurance Program.

ALTERNATIVES FOR FLOOD PLAIN MANAGEMENT

PRESENT CONDITIONS

Residences, businesses and public buildings are presently located within the study area flood plain and additional development is underway. Since flood hazard area maps have not been available prior to this study, the flood plain has been developed with very little regard to possible future flood damage.

LAND TREATMENT

Effective conservation land treatment is presently being carried out by land users in the watershed. Excess runoff or erosion and sedimentation due to lack of conservation land treatment is not a major cause of flooding.

PRESERVATION AND RESTORATION OF NATURAL VALUES

Since the primary natural value of the study area flood plain is its ability to transport floodwaters, encroachment onto the flood hazard areas of the flood plain with obstacles which interfere with the movement of floodwater should be avoided to preserve its present flowage capacity.

The woody areas along the streambanks in the flood plain are considered important environmental corridors and wildlife habitat. Provisions should be made to protect these woody areas in the planning and development of new urban areas.

Nonprime farmland soils should be used for construction sites and other non-farm uses in order to preserve prime farmland. Information on prime farmland soils in the study area may be obtained from the Soil Conservation Service Office at Caldwell, Texas.

NONSTRUCTURAL MEASURES

Nonstructural measures which will help reduce or minimize flood losses include flood proofing, flood warning systems, relocation, zoning regulations, participation in the national flood insurance program, emergency preparedness, and building or development codes.

Flood proofing can reduce flood damages by a combination of structural provisions and changes or adjustments to properties subject to flooding. Examples of flood proofing are sealing low window and door openings and modifying floor drains to prevent the entrance of flood waters.

Flood warning systems should be coordinated with local disaster plans. The National Weather Service issues warnings of potential flood producing storms. Staff gages set at key locations can be monitored to give advance warnings. A float-activated electronic signal could be connected to the local police or fire station for monitoring.

Relocation involves permanent evacuation of developed areas subject to inundation, acquisition of lands by purchase, removal of improvements and relocation of the population from such areas. Such lands could be used for parks or other purposes that would not suffer large damages and would not interfere with floodflows.

Zoning is a legal method used to implement and enforce the details of the flood plain management program, to preserve property values, and to achieve the most appropriate and beneficial use of available land. Clear, concise, and thorough zoning bylaws with enforcement of the bylaws are essential to make zoning effective.

Flood insurance was established by the National Flood Insurance Act of 1968 (Public Law 90-448, as amended) to make limited amounts of flood insurance, which were previously unavailable from private insurers, available to

property owners and occupiers. The Flood Disaster Protection Act of 1973 (Public Law 93-234, as amended) was a major expansion of the National Flood Insurance Program.

Flood insurance is available through local insurance agents and brokers only after a local governing body applies and is declared eligible for the program by the Federal Insurance and Hazard Mitigation Division of the Federal Emergency Management Agency (FEMA). Adoption and enforcement of a local flood prevention ordinance which meets FEMA minimum flood plain management criteria is necessary to qualify and maintain eligibility.

In those communities participating in the FEMA program, owners and occupiers of all buildings and mobile homes in the entire community are eligible to obtain flood insurance coverage. Where flood insurance is available, it is recommended that buildings and moble homes within or adjacent to the delineated flood hazard areas carry flood insurance on the structure and contents.

Emergency preparedness consists of a plan by local officials to be put into effect in the event of flooding. Procedures are worked out and personnel designated to implement the plan. Methods and procedures to alert and warn the populace of possible flooding are developed. High risk areas, handicapped, elderly or others known to need help during evacuation are located and identified. Plans are made for their evacuation or rescue. Shelters are provided for evacuees.

Building codes are developed to set up minimum standards for controlling the design, construction, and quality of materials used in buildings and structures within a given area to provide safety for life, health, property and public welfare. Building codes can be used to minimize structural and subsequent damages resulting from inundation. Building restriction codes can:

1. Specify adequate anchorage to prevent flotation of buildings from their foundations.

2. Establish basement elevations and minimum first-floor elevations in accordance with potential flood heights.

3. Prevent virtually all damage by elevating the foundation and prohibiting basements in those areas subject to very shallow and frequent flooding.

4. Require building reinforcement to withstand water pressure or high velocity flow and restrict the use of materials which deteriorate rapidly in the presence of water.

5. Prohibit equipment that might be hazarous to life when submerged. This includes chemical storage, boilers, and electrical equipment.

Development policies which are designed to prevent construction of streets and utility systems in flood prone areas tend to slow development of the flood plains.

STRUCTURAL MEASURES

Structural measures such as dams or channels were considered as a means of reducing flood losses. Channel modification of Old River Tributaries 1, 2, and 3 does not appear to be economically feasible. However, nuisance flooding caused by poor surface drainage could be reduced considerably by providing adequate drainage of trapped local surface runoff water. Floodwater retarding dams do not appear to be feasible due to the lack of favorable site locations.

SELECTED ALTERNATIVE

The alternative for reducing flood losses selected by the City of Snook for immediate implementation is to contact the Federal Insurance and Hazard Mitigation Division of the Federal Emergency Management Agency (FEMA) and apply for inclusion in the Regular National Flood Insurance Program. The City will adopt and implement the flood plain management ordinances necessary to qualify for and maintain eligibility in the Regular National Flood Insurance Program.

The city will also initiate steps to improve surface drainage by providing outlets for trapped local surface runoff water.

Other alternatives listed in this report will be considered for later implementation.

FLOOD HAZARD MAPS

The index map (Appendix, page 7) shows the stream reach covered by each of the photomaps. The index map also shows the watershed boundaries and stream reaches studied.

The limits of the 100-year and 500-year frequency floods, for present conditions, were delineated on aerial photographs (Appendix, pages 9 to 19) to indicate the extent of area inundated. The 10-year and 50-year frequency floods for present conditions could not be effectively shown on the aerial photographs due to the map scale and topography. The flood lines shown are based on field surveys of roads, bridges, and valley sections used in conjunction with Geological Survey topographic maps having 10-foot contour intervals, and interpretation of aerial photographs. These maps should only be used to determine the approximate boundaries of the flooded areas. Actual dimensions measured on the ground may vary slightly from those measured on the photomaps of this report due to map scale and reproduction limitations. The water surface profile elevations should be used to determine actual on the ground dimensions.

Flood elevations in this report are minimum elevations. Debris may collect at bridges and culverts and clog the channels during major floods and increase the depth of flooding. Analyses were made without showing the effects of potential obstructions. Also extremely rare events such as catastrophic storms were not analyzed.

TECHNICAL APPENDIX

A technical appendix is included in this report. The index map, flood hazard area photomaps and flood profiles are included in the Appendix. The index map shows the study area coverage of individual flood hazard area maps and the watershed boundaries (Appendix, page 7).

The water surface profiles of Old River Tributary 1, Old River Tributary 2, and Old River Tributary 3 show the profiles of the 10-year, 50-year, 100-year, and 500-year frequency floods for present conditions. Included on the profiles are stream elevations of the channel bottom, pertinent bridge and roadway data, and other location data. The stationing of profile is bank full stream channel distance in feet and is based on measured distances from the 1974 flight of aerial photomaps. Flood depths can be estimated at any location on the stream reach from the water surface profiles. The water surface profiles are included in the Appendix, pages 21 to 29. They consist of Old River Tributary 1, pages 21 to 25; Old River Tributary 2, page 27; and Old River Tributary 3, page 29. An index is included in the Appendix page 5, to assist the user in relating the flood hazard area photomaps to the appropriate water surface profile.

Cross sections, representative of the streams studied, have been plotted to illustrate the shape of that stream and its flood plain. The 10-year, 50-year, 100-year, and 500-year floodwater surface elevations are shown on the plotted cross section to illustrate the effect of various flood depths (see Appendix, pages 31 to 33).

The elevations, discharges and flood plain width of the 10-year, 50-year, 100-year and 500-year floods at surveyed cross sections are shown in Appendix Table 2. Each cross section is listed by number on this table. Each cross section is also identified by number on flood hazard area photomaps. The user can locate a cross section on the photomap, turn to Table 2, (Appendix, pages 35 to 36) and read the discharge, elevation, and flood plain width directly from the table.

Also, included in the Appendix is a list of elevation reference marks showing the elevation and location of each. Additional data are on file in the USDA Soil Conservation Service State Office, W.R. Poage Federal Building, 101 South Main Street, Temple, Texas 76501-7682.

GLOSSARY

Channel -- A natural stream that conveys water; a ditch or channel excavated for the flow of water.

Channel Bottom -- The elevation of the deepest part of a stream channel at a particular cross section.

Channel Modification -- The modification of the flow characteristics of a channel by clearing, excavation, realignment, lining, or other means to increase its capacity; sometimes used to connote channel stabilization.

Flood -- An overflow or inundation that comes from a river or other body of water and causes or threatens damage.

Flood Frequency -- A means of expressing the probability of flood occurrences as determined from a statistical analysis of representative stream flow or rainfall and runoff records. A 10-year frequency flood would have an average frequency of occurrence in the order of once in 10 years (a ten percent chance of being equalled or exceeded in any given year). A 50-year frequency flood would have an average frequency of occurrence in the order of once in 50 years (a two percent chance of being equalled or exceeded in any given year). A 100-year frequency flood would have an average frequency of occurrence in the order of once in 100 years (a one percent chance of being equalled or exceeded in any given year). A 500-year frequency flood would have an average frequency of occurrence in the order of once in 500 years (a 0.2 percent chance of being equalled or exceeded in any given year).

Flood Peak -- The highest value of the stage or discharge attained by a flood, thus, peak stage or peak discharge.

Flood Plain -- 1. Nearly level land situated on either or both sides of a channel which is subject to overflow flooding. 2. Lowland and relatively flat alluvial areas adjoining inland and coastal waters (streams, bays, etc.), including flood-prone areas of off shore islands.

500-Year Flood Plain -- The land that would be flooded on an average of once every 500 years.

100-year Flood Plain -- The land that would be flooded on an average of once every 100 years.

Flood Profile -- A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage -- The stage at which overflow of the natural banks of a stream begins to cause damage in the reach in which the elevation is measured.

High Water Mark (HWM) -- The maximum observed and recorded height or elevation that floodwater reaches during a storm, usually associated with the flood peak. The high water mark may be referenced to a particular building, bridge or other landmark, or based on debris deposits on bridges, fences, or other evidence of the flood.

Low Bank -- The highest elevation of a specific channel cross section at which the water will be contained without overflowing onto adjacent flood plain areas.

Runoff -- That portion of the precipitation on a drainage area that is discharged from the area in stream channels; types include surface runoff, groundwater runoff, or seepage.

Structural Bottom of Opening -- The lowest point of a culvert or bridge opening with a constructed bottom through which a stream flows that could tend to limit the stream channel bottom to that specific elevation. This structural bottom may be covered with sediment or debris which further restricts the size of the opening.

Top of Opening -- The lowest point of a bridge, culvert, or other structure over a river, stream or watercourse that limits the height of the opening through which water flows. This is referred to as "low steel" or "low chord" in some regions.

Water Surface Profile -- A graph showing the relationship of water surface elevation to stream channel location for a specific flood event.

Watershed -- All land and water within the confines of a drainage divide.

Watershed Boundary -- The divide separating one drainage basin from another.

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APPENDIX

APPENDIX

TABLE OF CONTENTS

	Page
TECHNICAL APPENDIX	1
INVESTIGATIONS AND ANALYSES	1
Field Surveys	1
Hydrologic and Hydraulic Methods	2
Flood Hazard Evaluation	3
Estimates of Flood Losses	3
Inventory of Natural Values	3
Public Participation	4
Management Alternatives	4
INDEX TO FLOOD HAZARD AREA PHOTOMAPS AND WATER SURFACE PROFILES	5
PHOTOMAP INDEX	7
FLOOD HAZARD AREA PHOTOMAPS	9
FLOOD PROFILES	21
PLOTTINGS OF TYPICAL STREAM CROSS SECTIONS	31
ELEVATION AND DISCHARGE TABULATIONS	35
ELEVATION REFERENCE MARKS	37

TECHNICAL APPENDIX

This Technical Appendix to the City of Snook Flood Plain Management Study Report is a compilation of the FPMS technical findings. It includes the photomap index, flood hazard area photomaps, flood profiles, plottings of typical stream cross sections, elevation and discharge tabulations and a listing of pertinent elevation reference marks. Other technical data developed during this study are on file in the USDA Soil Conservation Service State Office, W.R. Poage Federal Building, 101 South Main Street, Temple, Texas 76501-7682.

INVESTIGATIONS AND ANALYSES

FIELD SURVEYS

Topographic data were obtained from Geological Survey topographic maps and field surveys. Engineering surveys were made of cross sections selected to represent the stream hydraulics and flood plain areas (refer to the sheets of typical valley cross section, Appendix, pages 31 to 33). Elevations appearing in this report are based on mean National Geodetic Vertical Datum of 1929. Temporary elevation reference marks were established by American Geodetic Survey Company in 1984. Table 3 Appendix, pages 37 to 40, shows the listings, descriptions, and location of permanent and temporary elevation reference marks.

HYDROLOGIC AND HYDRAULIC METHODS

The Old River Tributaries 1, 2, and 3 watershed boundaries were determined by use of Geological Survey topographic maps. The top of the watershed begins approximately 3.0 miles southwest of the Snook city limits. Hydraulic evaluations were based on synthetic frequency methods. Rainfall frequency data were obtained from Weather Bureau Technical Paper No. 40, Rainfall Frequency Atlas of the United States. Values greater than the 100-year frequency event were determined by extrapolation of the rainfall versus frequency graph. Peak discharge values were obtained using Geological Survey Water Resources Investigations 77-110 Open-File Report, "Technique for Estimating the Magnitude and Frequency of Floods in Texas."

From the representative stream and road cross sections, water surface profiles were developed by the Modified Slope Area Method. The effects of bridges and culverts on the stream hydraulics were determined by use of the Bureau of Public Roads (BPR) Method. Computations were made using SCS's "WSP2, A Computer Program for Determining Flood Elevations and Flood Areas for Certain Flow Rates". Using the output data from this program, rating curves were plotted for each cross section. These curves show the relationship between stage or elevation and discharge. Water surface profiles were developed from these rating curves and the discharges obtained using Geological Survey Water Resources Investigations 77-110 Open-File Report, "Technique for Estimating the Magnitude and Frequency of Floods in Texas."

FLOOD HAZARD EVALUATION

The 500-year and 100-year frequency flood hazard areas are outlined on aerial photographs obtained from the December 1974 Agricultural Conservation and Stabilization Service flight. The flood hazard area boundaries were developed by plotting the computed water surface elevations on the surveyed cross sections and transposing this information to the aerial photographs. The flood hazard areas between the surveyed cross sections were developed through interpretation of Geological Survey topographic maps and the aerial photographs in conjunction with the surveyed cross sections. Actual flood limits may vary slightly on the ground from the outlined area on the photomaps due to map scale and reproduction limitations. For this reason, the water surface elevations from the flood profiles should be used for determining site specific potential flood depths.

ESTIMATES OF FLOOD LOSSES

The number and type of buildings located within the delineated flood hazard areas were determined by Soil Conservation Service personnel through on-the-ground reconnaissance and interviews with local people. Potential flood depths and resulting flood damages were then estimated.

INVENTORY OF NATURAL VALUES

The natural values of the study area flood plain were determined by the Soil Conservation Service, Basin and Area Planning staff biologist through on-the-ground reconnaissance, interviews of local people and literature search.

PUBLIC PARTICIPATION

The City of Snook Flood Plain Management Study Plan of Work was developed through consultation with the local officials and study endorsers.

A public meeting was held during preparation of the report draft in order to get public input and participation.

MANAGEMENT ALTERNATIVES

Nonstructural management alternatives were considered during the flood plain management study and discussed during meetings with local public officials and other interested members of the public. Those considered to have merit and worthy of further study for possible implementation were put in the report.

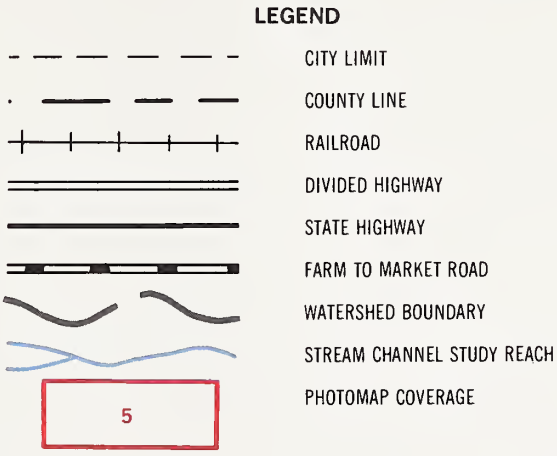
INDEX

TO

CITY OF SNOOK FLOOD PLAIN MANAGEMENT STUDY

FLOOD HAZARD AREA PHOTOMAPS AND WATER SURFACE PROFILES

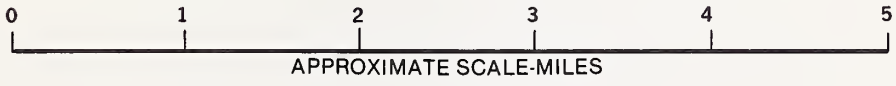
Cross Section Number	Flood Hazard Area Photomap Sheet Number	Water Surface Profile Sheet Number
OLD RIVER TRIBUTARY NO. 1		
1	1	1
2	1, 4	1
3	1, 2, 4	1, 4
4	1, 4	1
5	4, 5	1
6	4, 5	2
7	4, 5	2, 5
8	4, 5	2, 5
9	4, 5	2
10	5, 6	3
11	5, 6	3
OLD RIVER TRIBUTARY 2		
12	1, 2	4
13	1, 2	4
14	2	4
15	2	4
OLD RIVER TRIBUTARY 3		
16	3, 4, 5	5
17	3, 4, 5	5
18	3, 4	5
19	3, 4	5
20	3, 4	5
21	3, 4	5



INDEX MAP

CITY OF SNOOK
FLOOD PLAIN MANAGEMENT
STUDY AREA

BURLESON COUNTY, TEXAS



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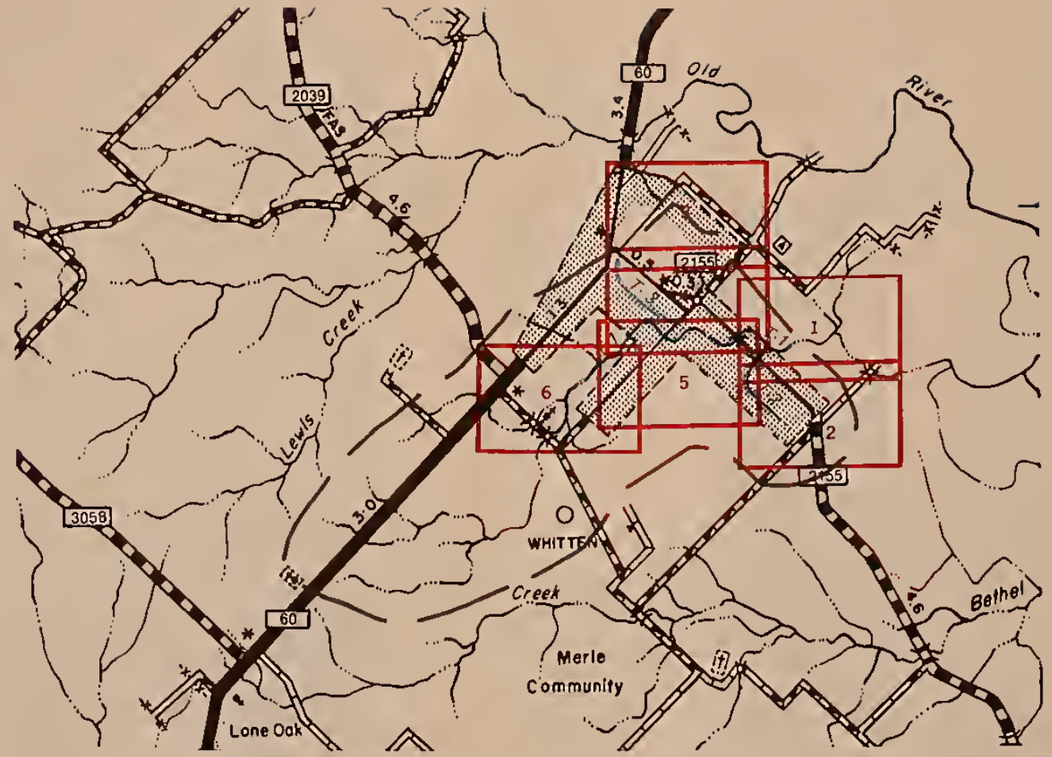

LEGEND

- CITY LIMIT
- COUNTY LINE
- RAILROAD
- DIVIDED HIGHWAY
- STATE HIGHWAY
- FARM TO MARKET ROAD
- WATERSHED BOUNDARY
- STREAM CHANNEL STUDY REACH
- PHOTOMAP COVERAGE (5)

INDEX MAP

CITY OF SNOOK
FLOOD PLAIN MANAGEMENT
STUDY AREA

BURLESON COUNTY, TEXAS

VICINITY MAP

0 1 2 3 4 5

APPROXIMATE SCALE-MILES

0 1 2 3 4 5

APPROXIMATE SCALE-KILOMETERS

SOURCE: COUNTY HIGHWAY MAP. POLYCONIC PROJECTION

USDA SCS NATIONAL CARTOGRAPHIC CENTER FT. WORTH, TX. 1985

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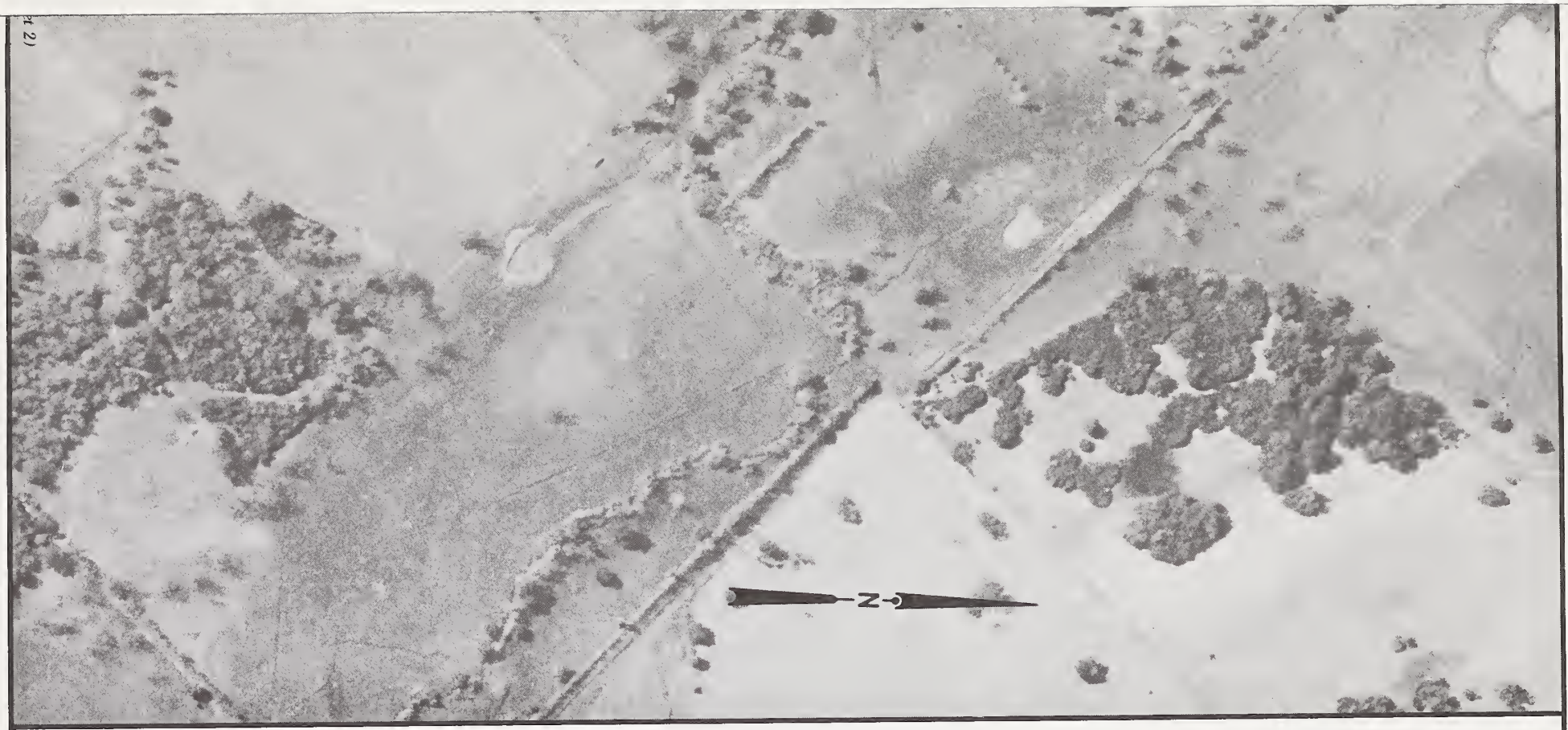

LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Cross Section Location

Stream Channel

X Elevation Reference Marks

1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET

0 100 200 METERS

APPROXIMATE

A.S.C.S. Photography 12/1/74

SHEET 1 OF 6

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

FLOOD HAZARD AREA

CITY OF SNOOK

OCTOBER 1985 4-R-38814

(Joins Sheet 2)

(Joins Sheet 3)

FM 2155

SNOOK

SNOOK CITY LIMIT

1000

1000

1000

Tributary 1

SNOOK CEMETERY

ERM 1.3

(Joins Sheet 2)

N

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 12/1/74

SHEET 1 OF 6

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CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

FLOOD HAZARD AREA

CITY OF SNOOK

OCTOBER 1975 4-38814

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 12/1/74

SHEET 2 OF 6

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SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

FLOOD HAZARD AREA

CITY OF SNOOK

OCTOBER 1985 4-R-38814

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- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 Channel Station

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0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 12/1/74

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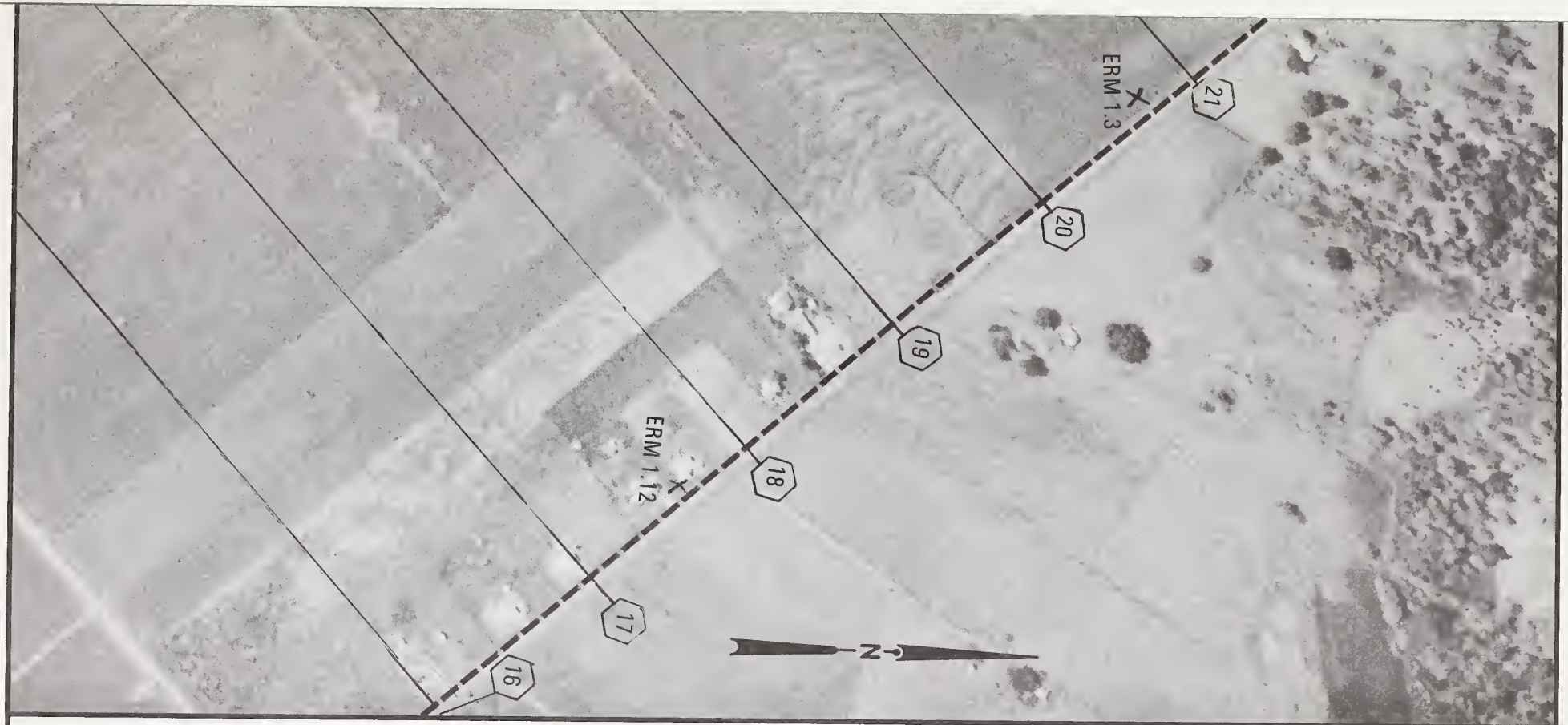
SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

FLOOD HAZARD AREA

CITY OF SNOOK

SHEET 2 OF 6

OCTOBER 1985 4-R-38814



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- Stream Channel
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APPROXIMATE

A.S.C.S. Photography 12/1/74

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CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

SHEET 3 OF 6

FLOOD HAZARD AREA

CITY OF SNOOK

OCTOBER 1985 4-R-38814

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SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

SHEET 3 OF 6

FLOOD HAZARD AREA

CITY OF SNOOK

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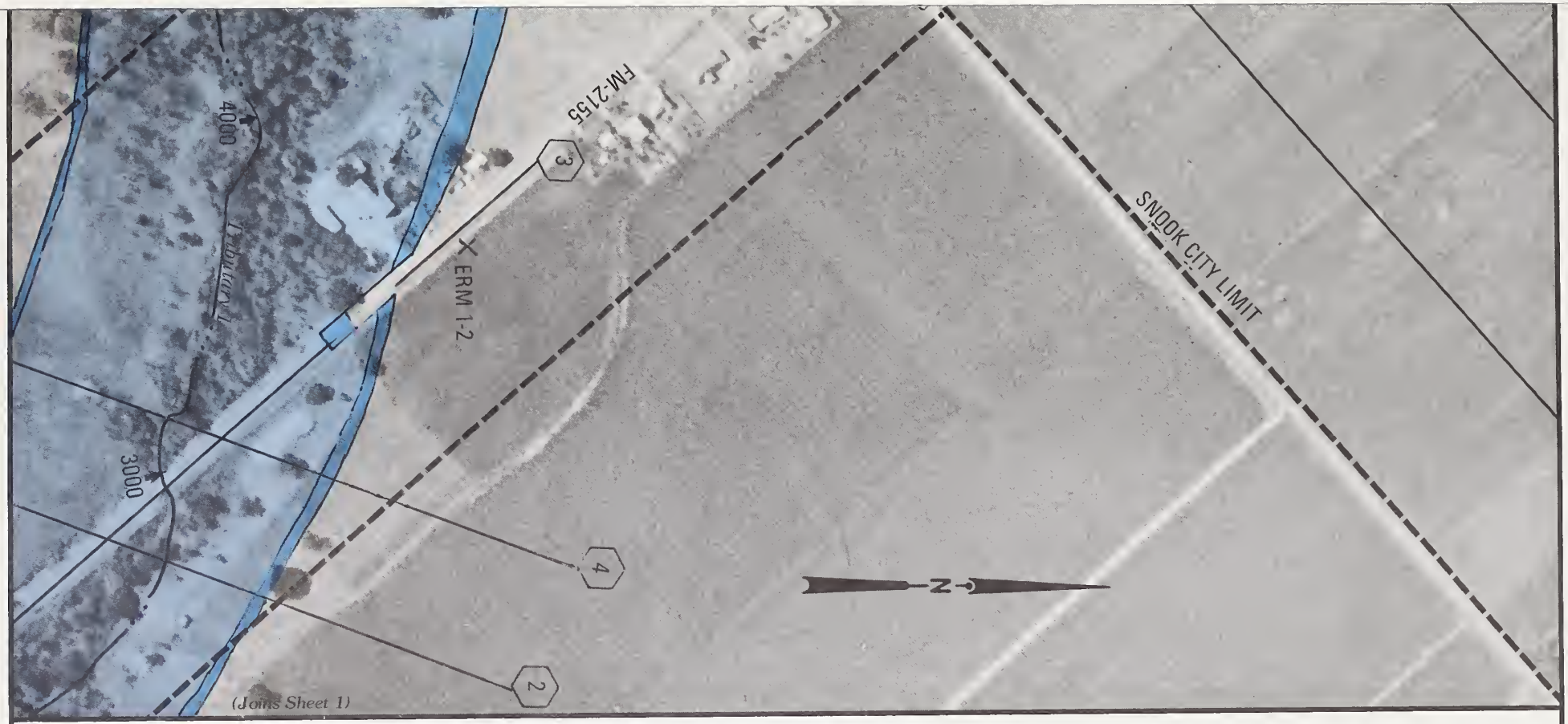

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- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

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SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 12/1/74

SHEET 4 OF 6

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

FLOOD HAZARD AREA

CITY OF SNOOK

OCTOBER 1985 4-R-38814

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A.S.C.S Photography 12/1/74

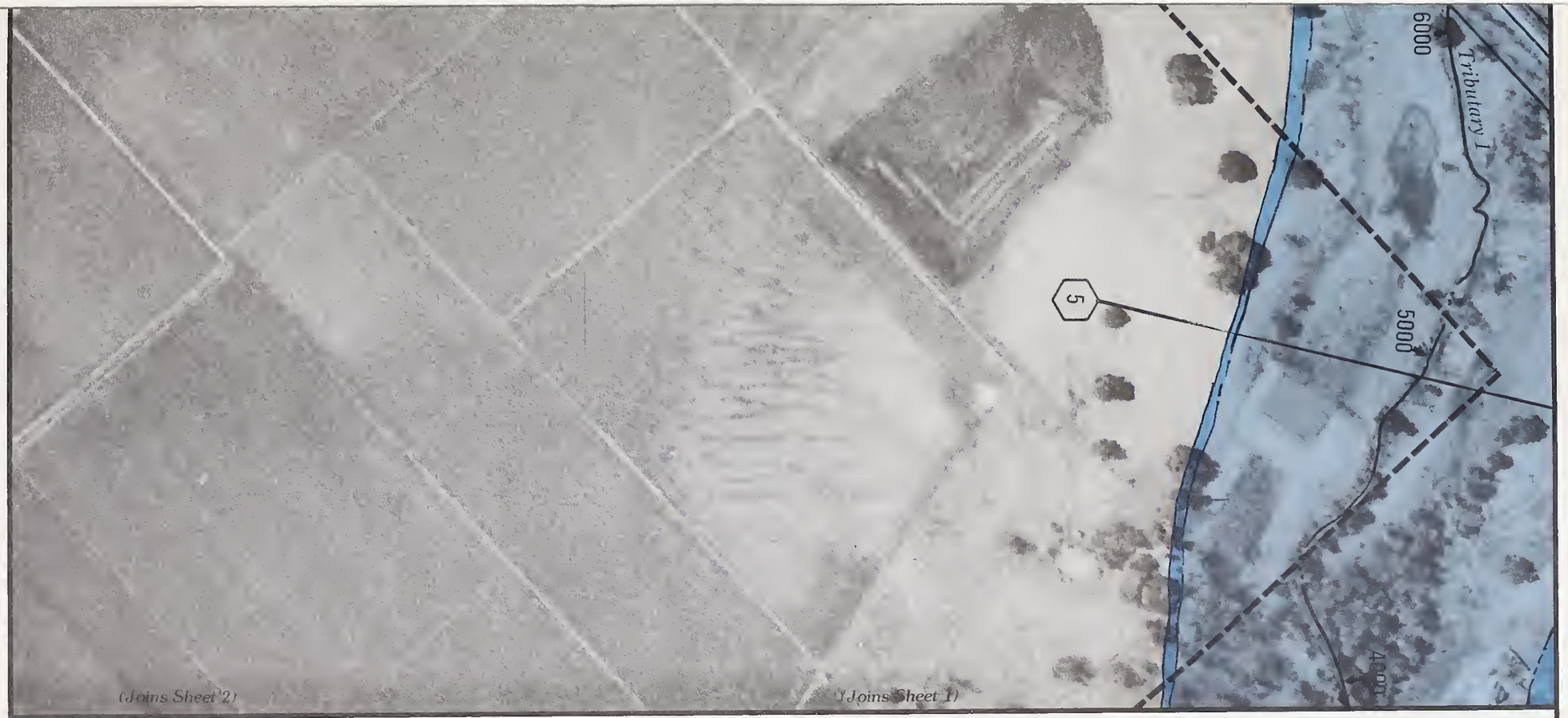
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

FLOOD HAZARD AREA

CITY OF SNOOK

SHEET 4 OF 6

OCTOBER 1985 4-R 38914



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A.S.C.S. Photography 12/1/74

SHEET 5 OF 6

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SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

FLOOD HAZARD AREA

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OCTOBER 1985 4-R-38814

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SHEET 5 OF 6

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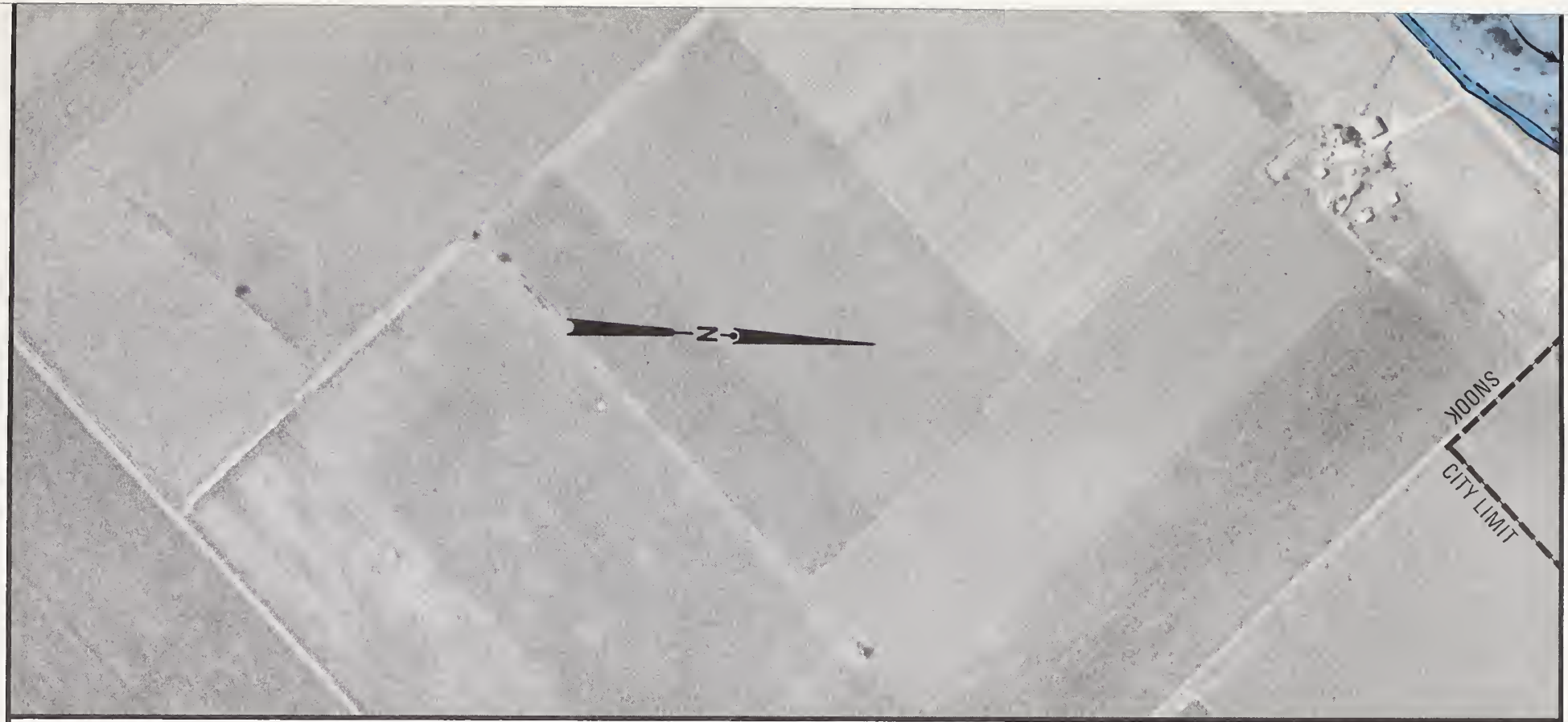
SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

FLOOD HAZARD AREA

CITY OF SNOOK

OCTOBER 1985 4-R-38814



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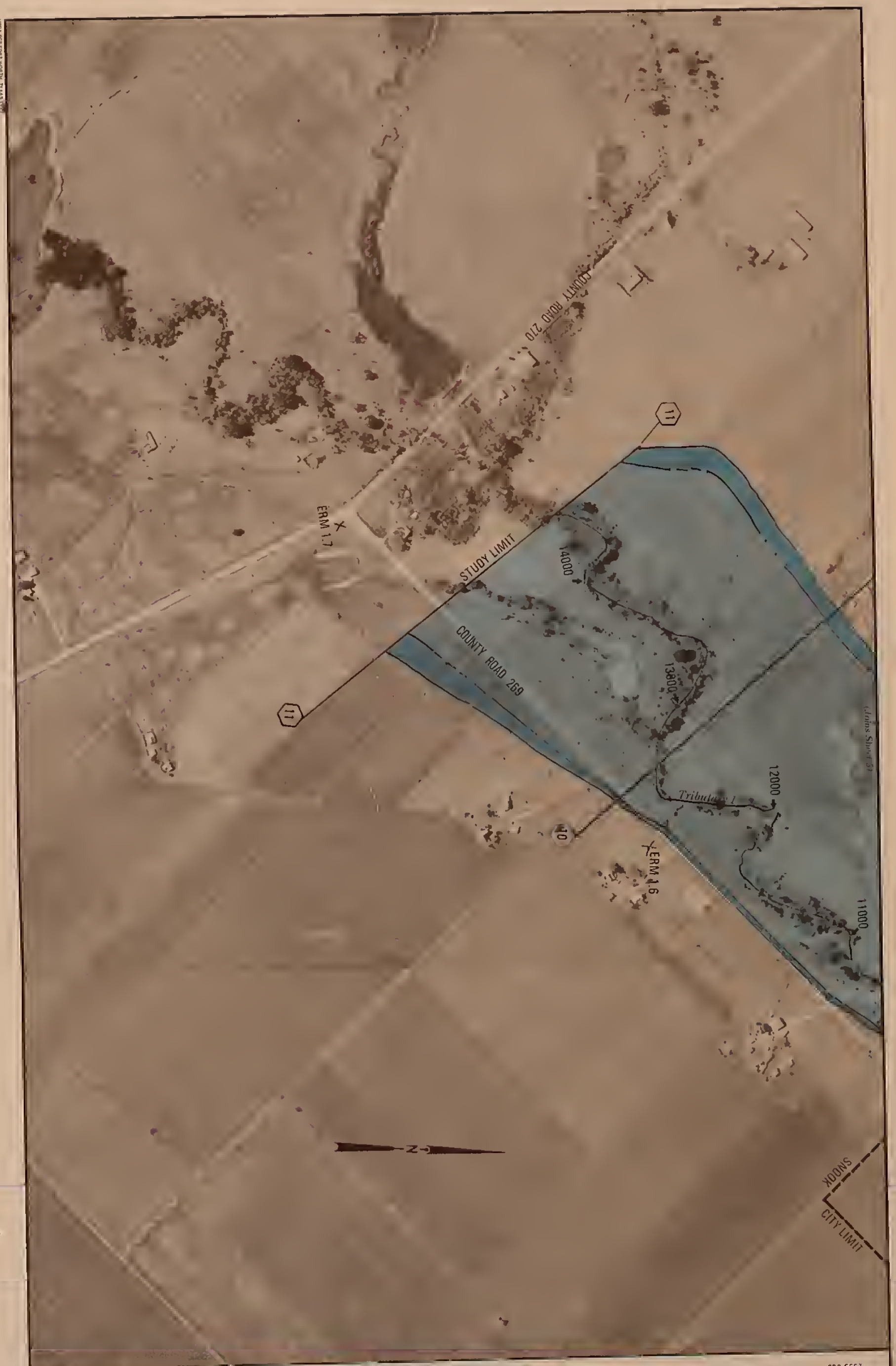
SHEET 6 OF 6

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

FLOOD HAZARD AREA

CITY OF SNOOK

OCTOBER 1985 4-R-38814



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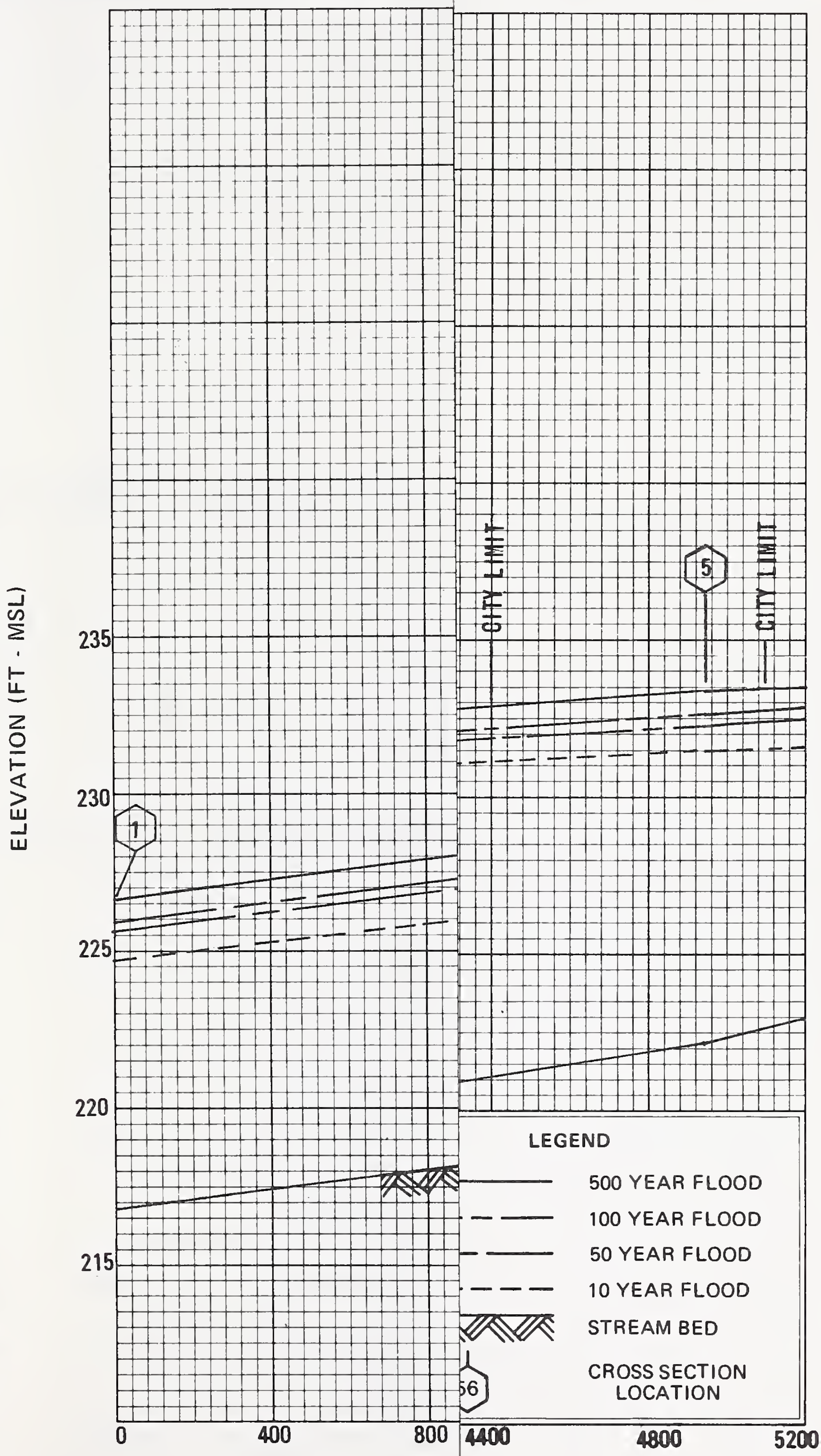
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

SHEET 6 OF 6

FLOOD HAZARD AREA

CITY OF SNOOK

OCTOBER 1985 4-R-38814



OLD RIVER TRIBUTARY 1

WATER SURFACE PROFILES

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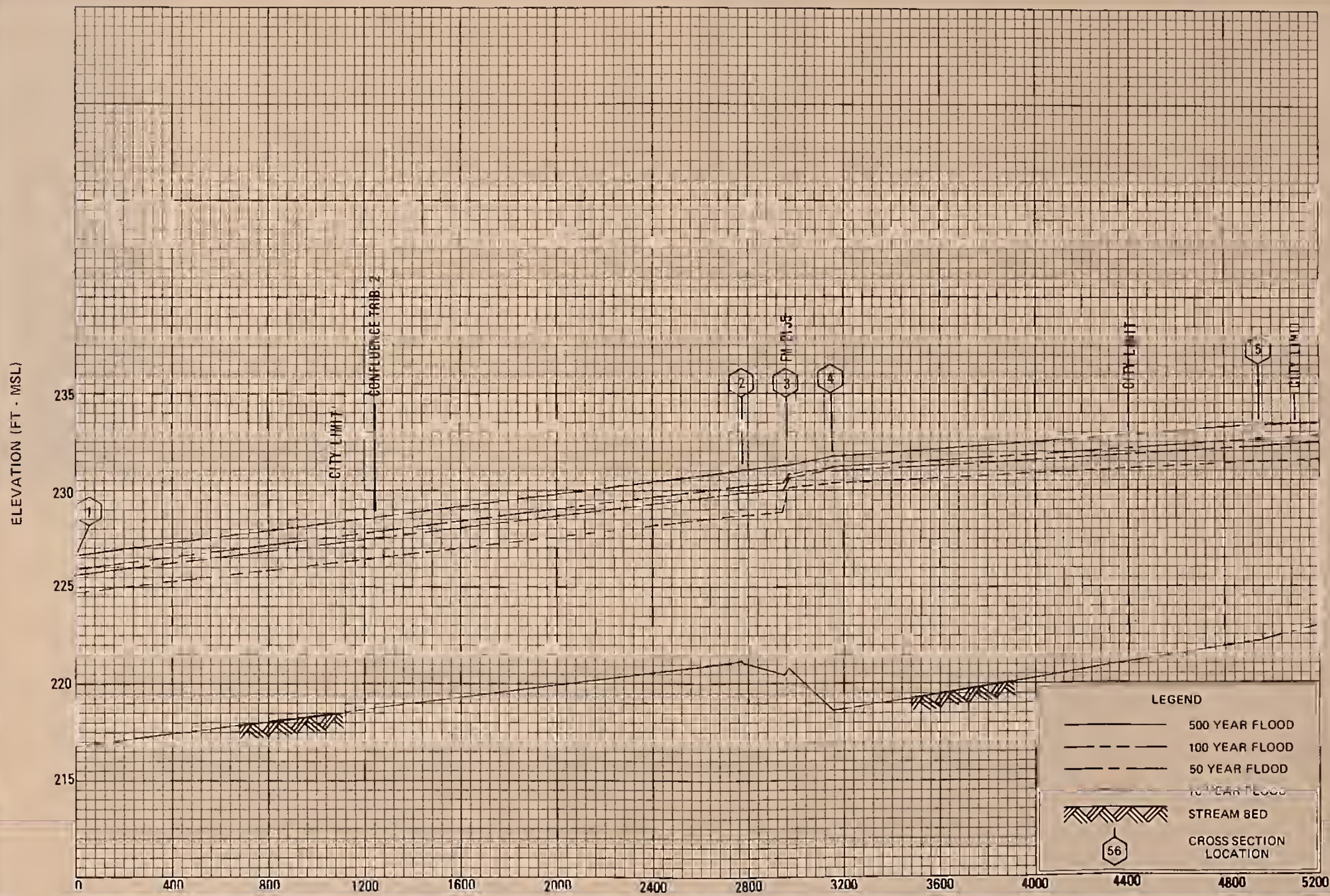
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

SHEET 1 OF 5

OLD RIVER TRIBUTARY 1

WATER SURFACE PROFILES



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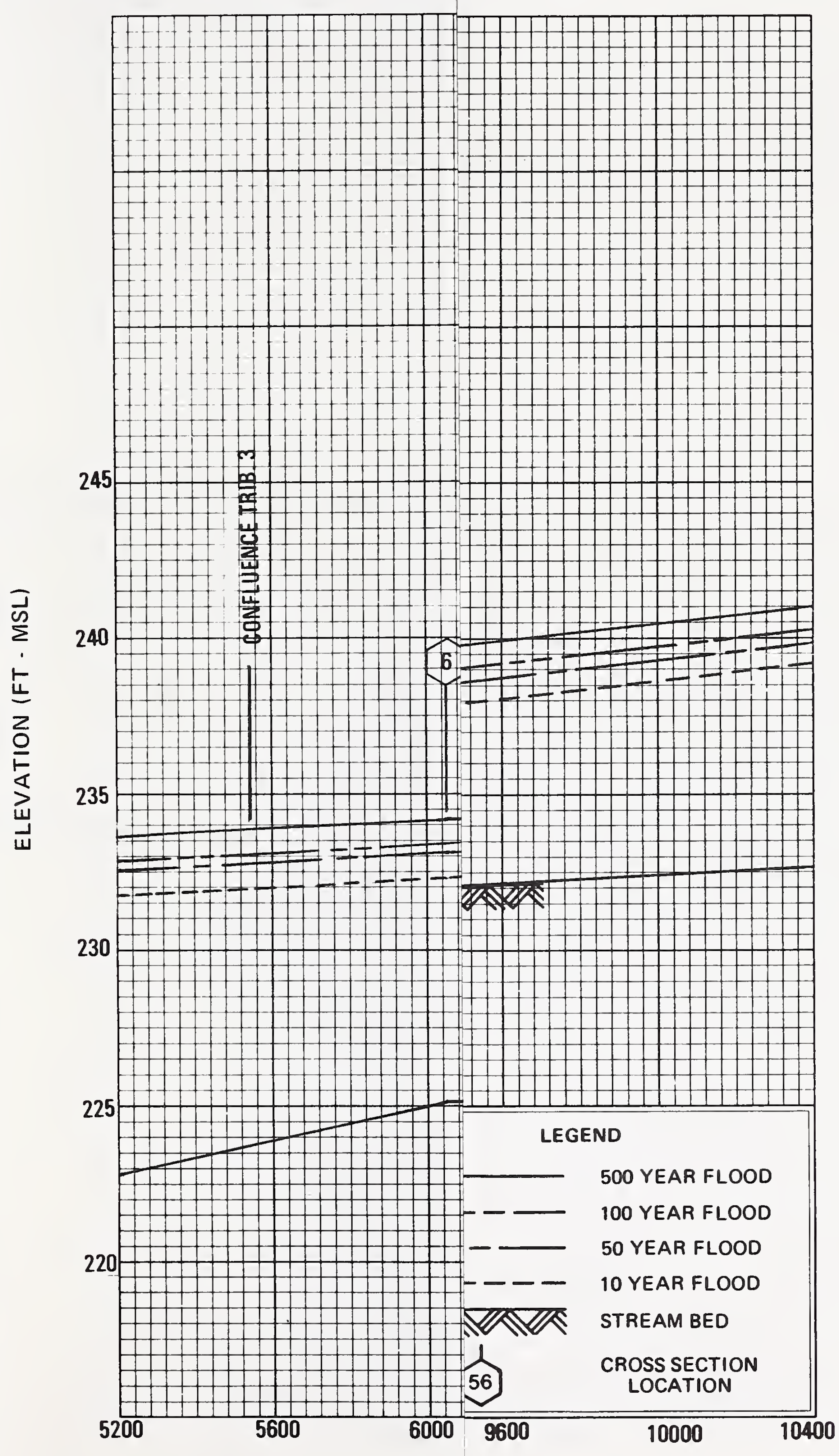
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

SHEET 3 OF 5



OLD RIVER TRIBUTARY 1

WATER SURFACE PROFILES

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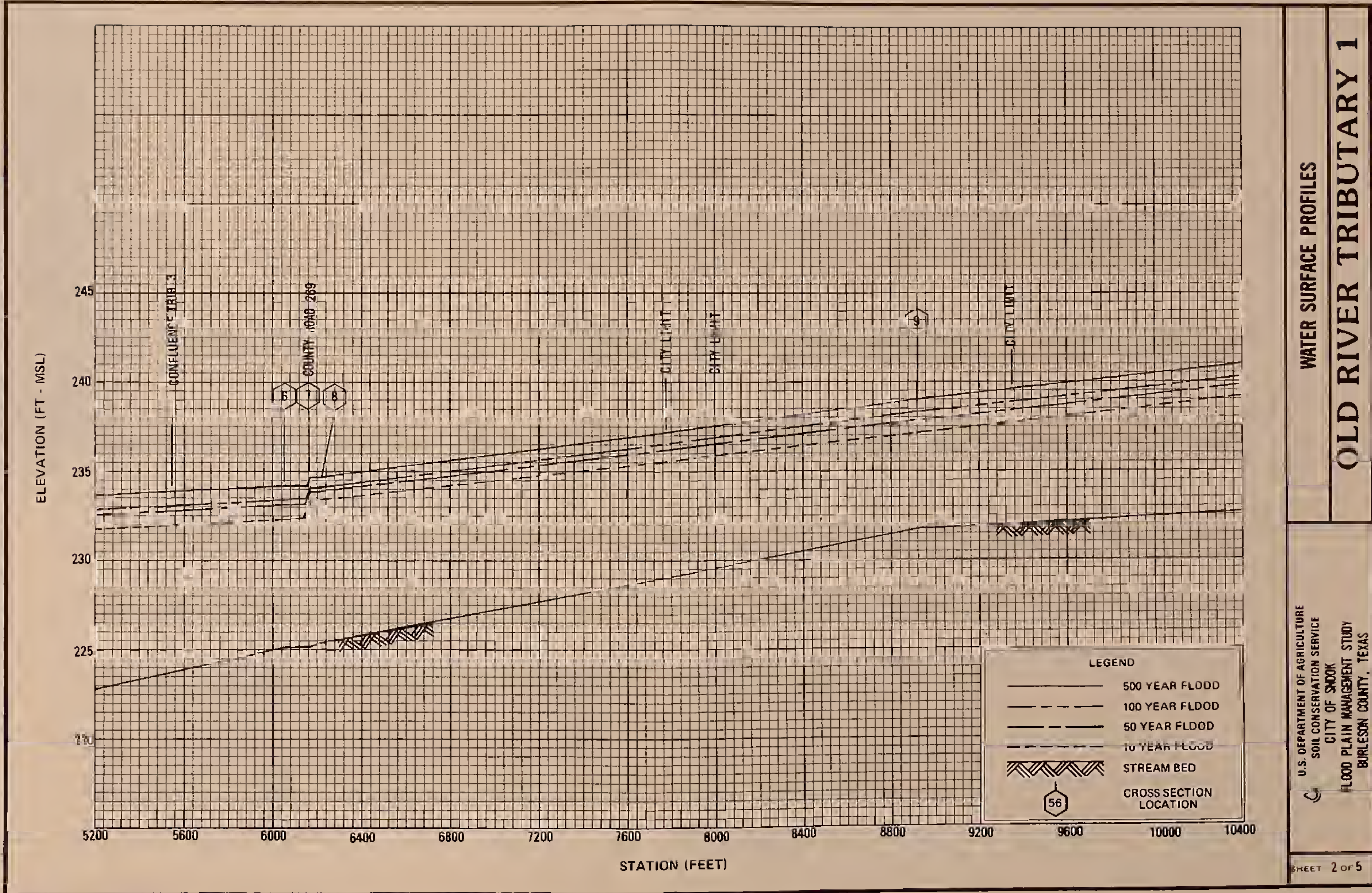
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

SHEET 2 OF 5



WATER SURFACE PROFILES
OLD RIVER TRIBUTARY 1
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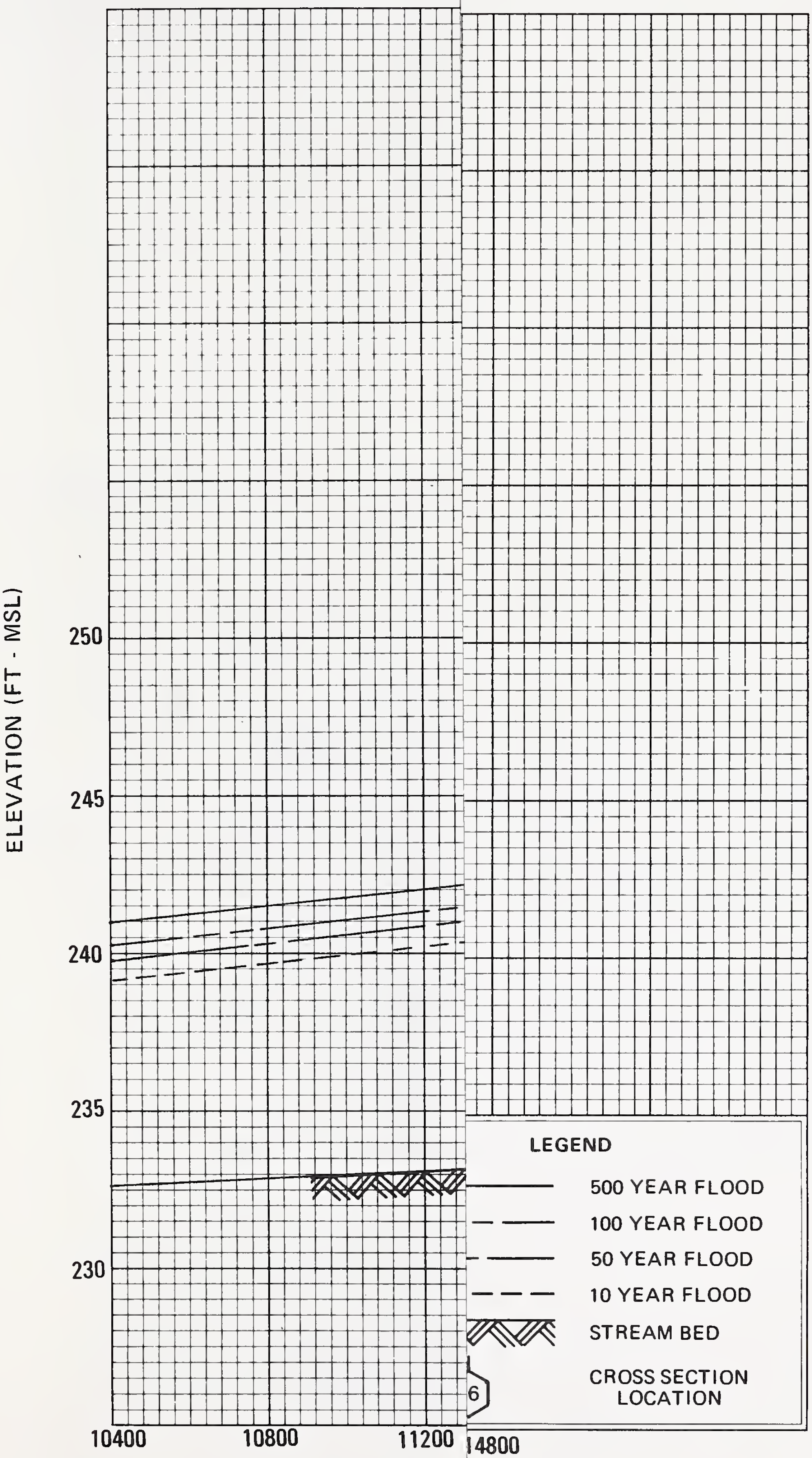
SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS
SHEET 2 OF 5
CONFLUENCE TRIB. 3
COUNTY ROAD 289
CITY LIMIT
CITY LIMIT
CITY LIMIT
6
7
8
9
ELEVATION (FT - MSL)
245
240
235
230
225
220
STATION (FEET)
5200
5600
6000
6400
6800
7200
7600
8000
8400
8800
9200
9600
10000
10400
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
56
CROSS SECTION LOCATION



WATER SURFACE PROFILES

OLD RIVER TRIBUTARY 1

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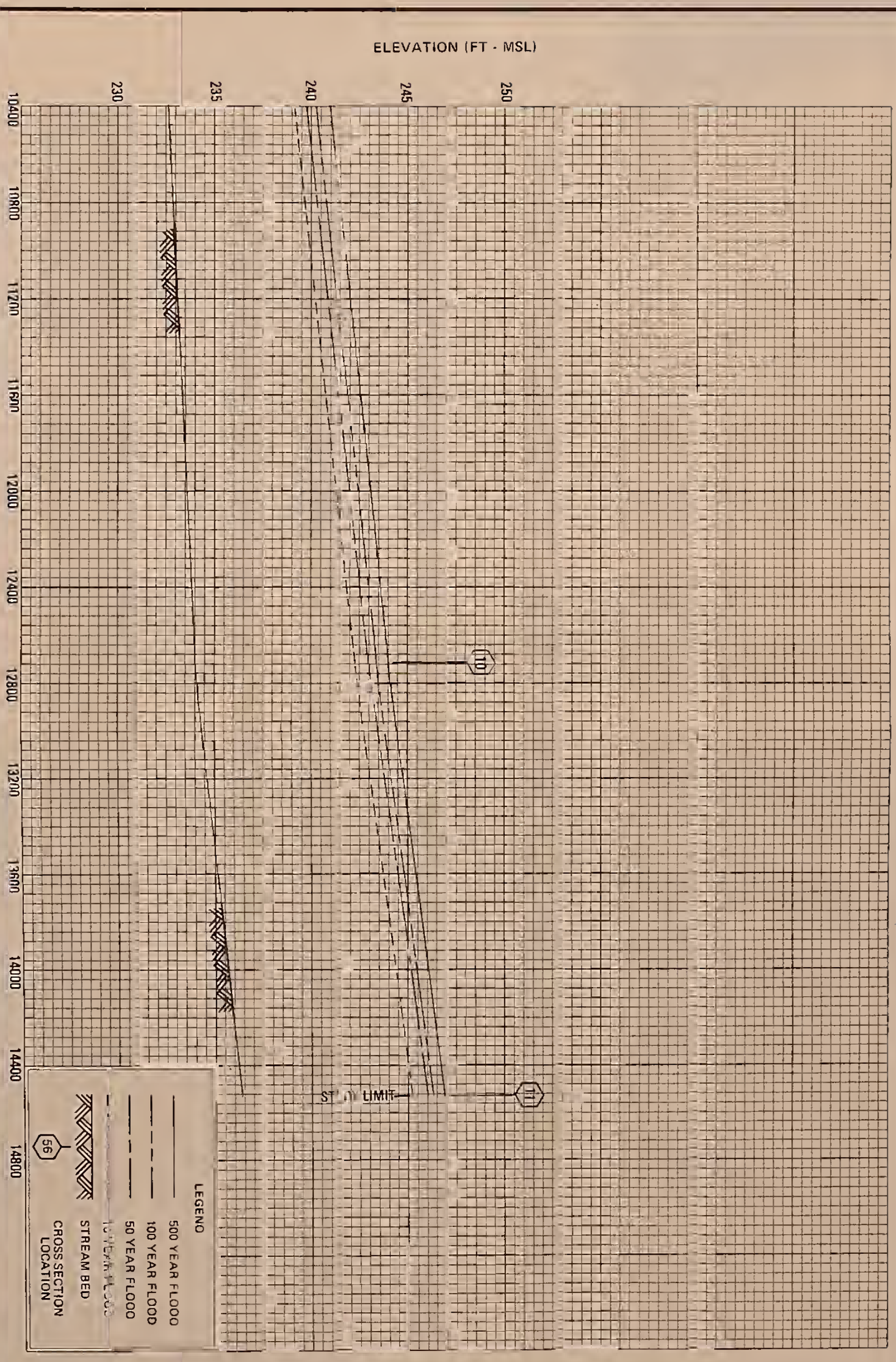
SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

SHEET 3 OF 5



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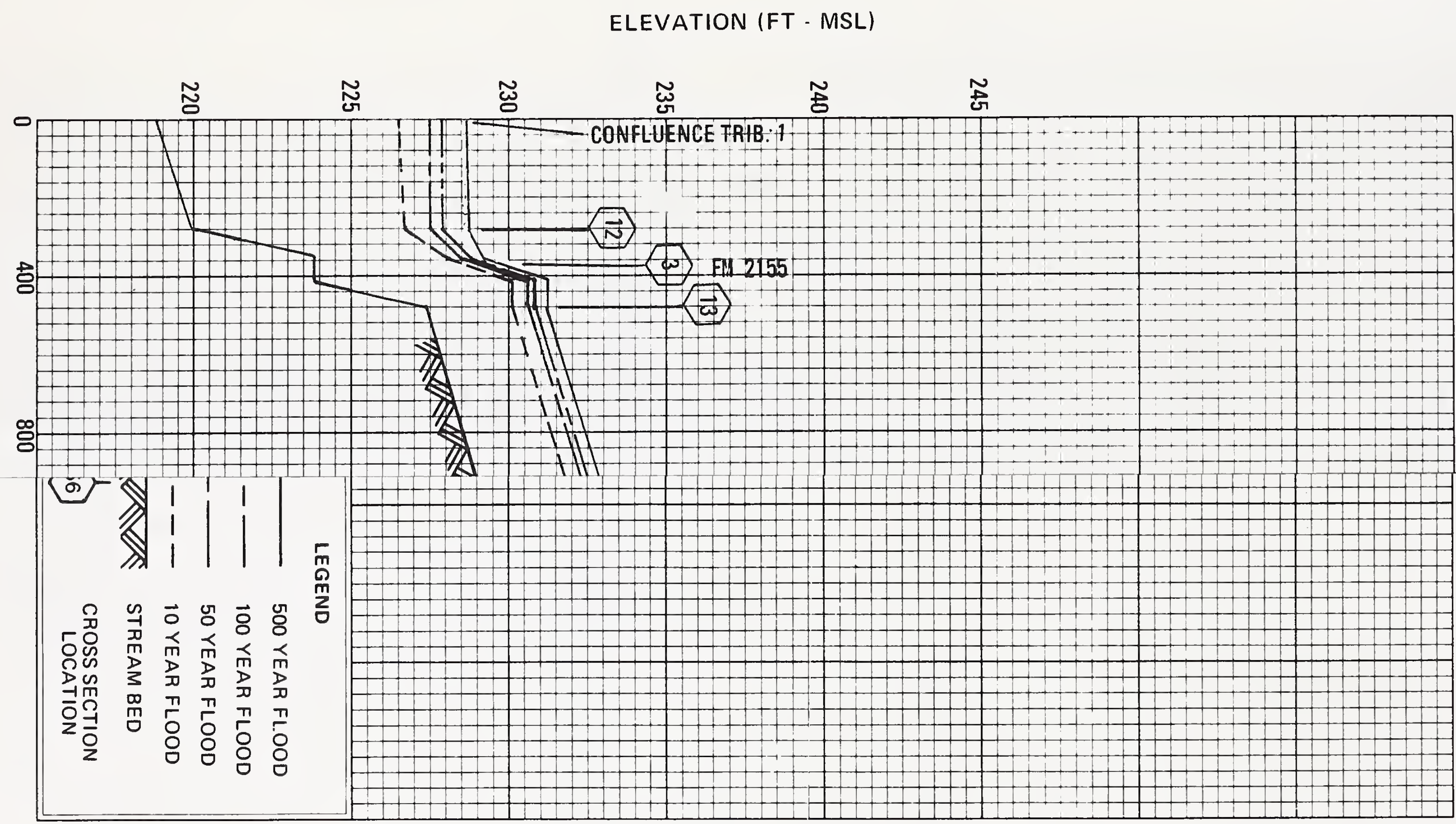
SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

SHEET 3 OF 5

WATER SURFACE PROFILES

OLD RIVER TRIBUTARY 1



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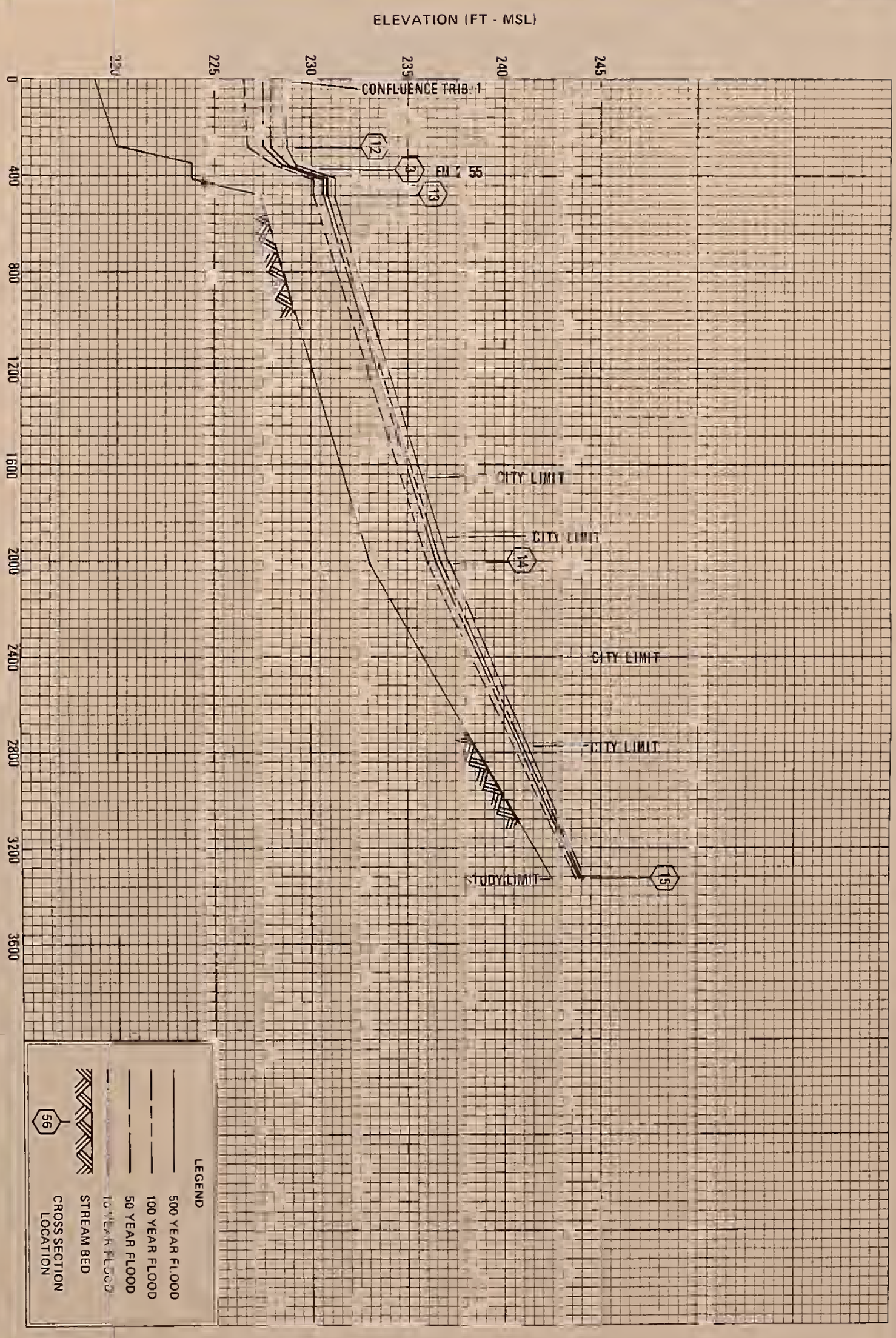
SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

WATER SURFACE PROFILES

OLD RIVER TRIBUTARY 2

SHEET 4 OF 5



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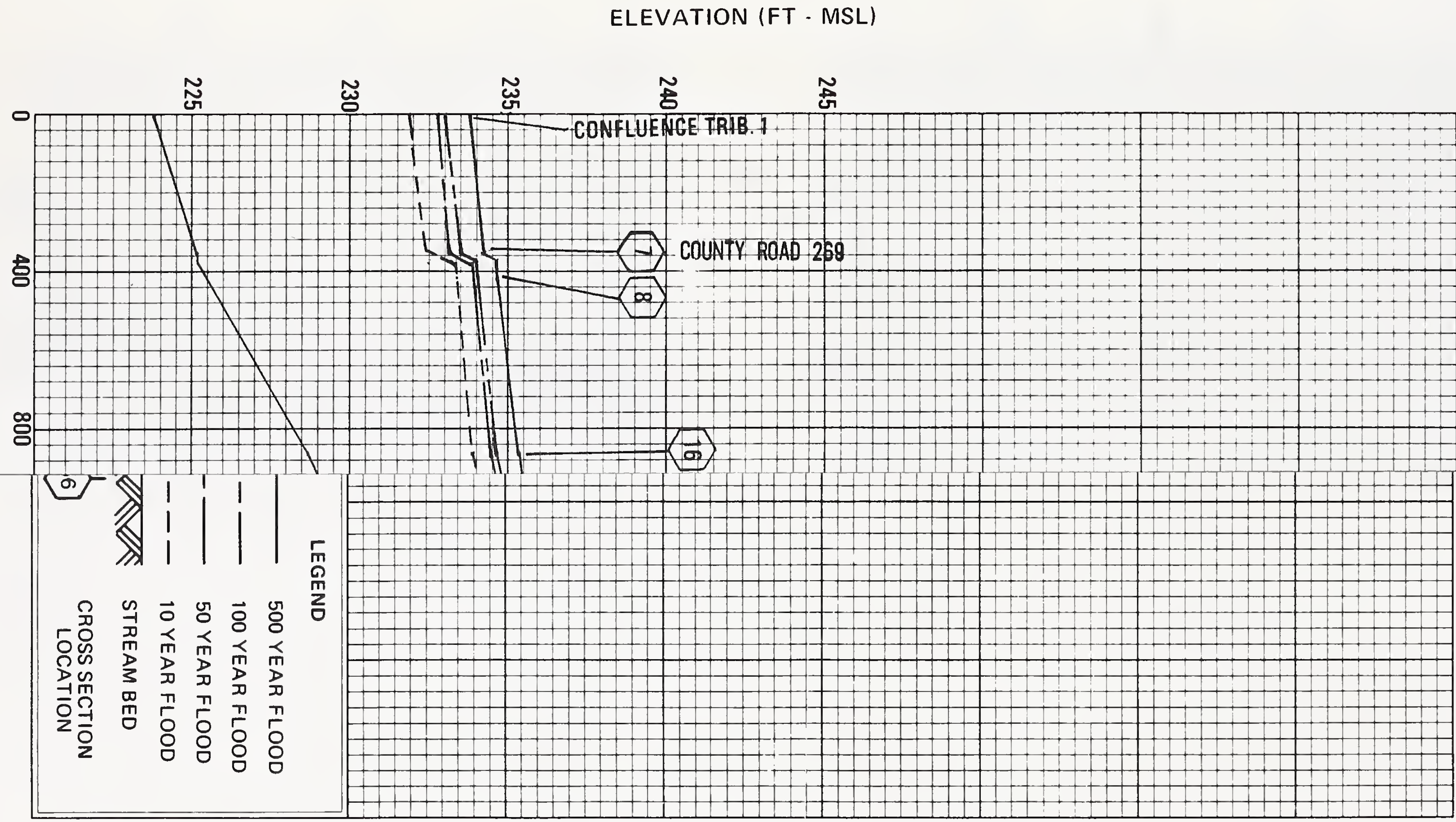
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

WATER SURFACE PROFILES

OLD RIVER TRIBUTARY 2

SHEET 4 OF 5



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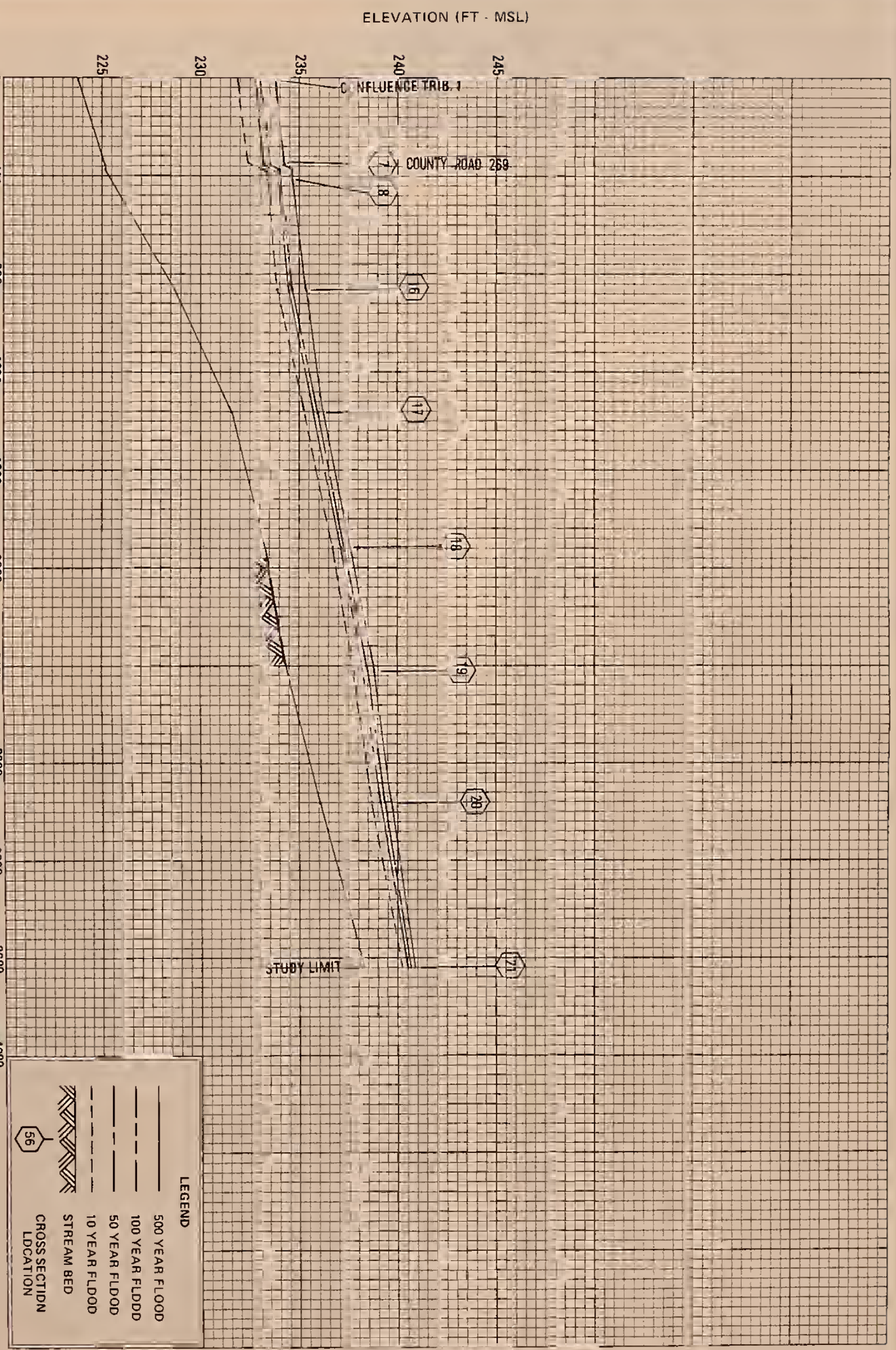
BURLESON COUNTY, TEXAS

WATER SURFACE PROFILES

OLD RIVER TRIBUTARY 3

SHEET 5 OF 5



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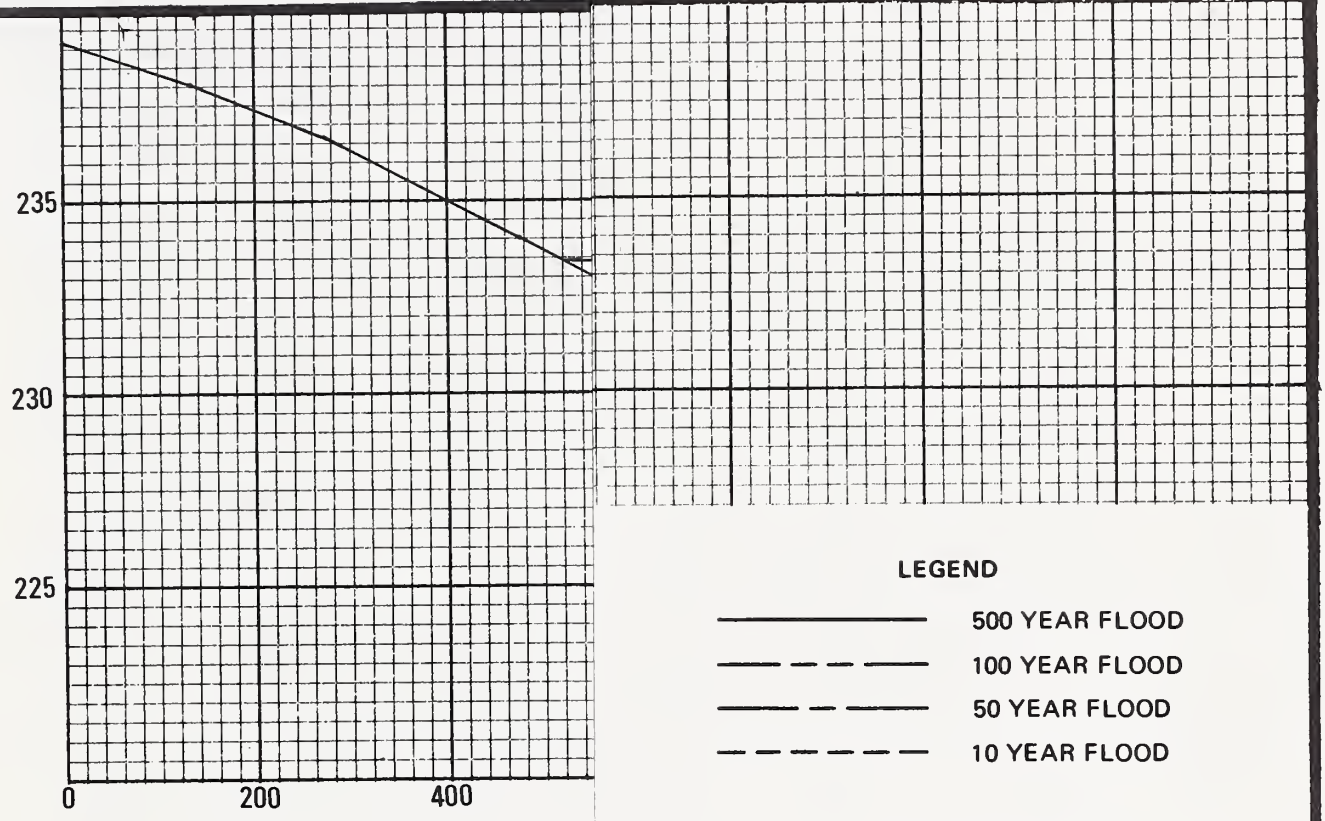
SOIL CONSERVATION SERVICE
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

SHEET 5 OF 5

WATER SURFACE PROFILES

OLD RIVER TRIBUTARY 3



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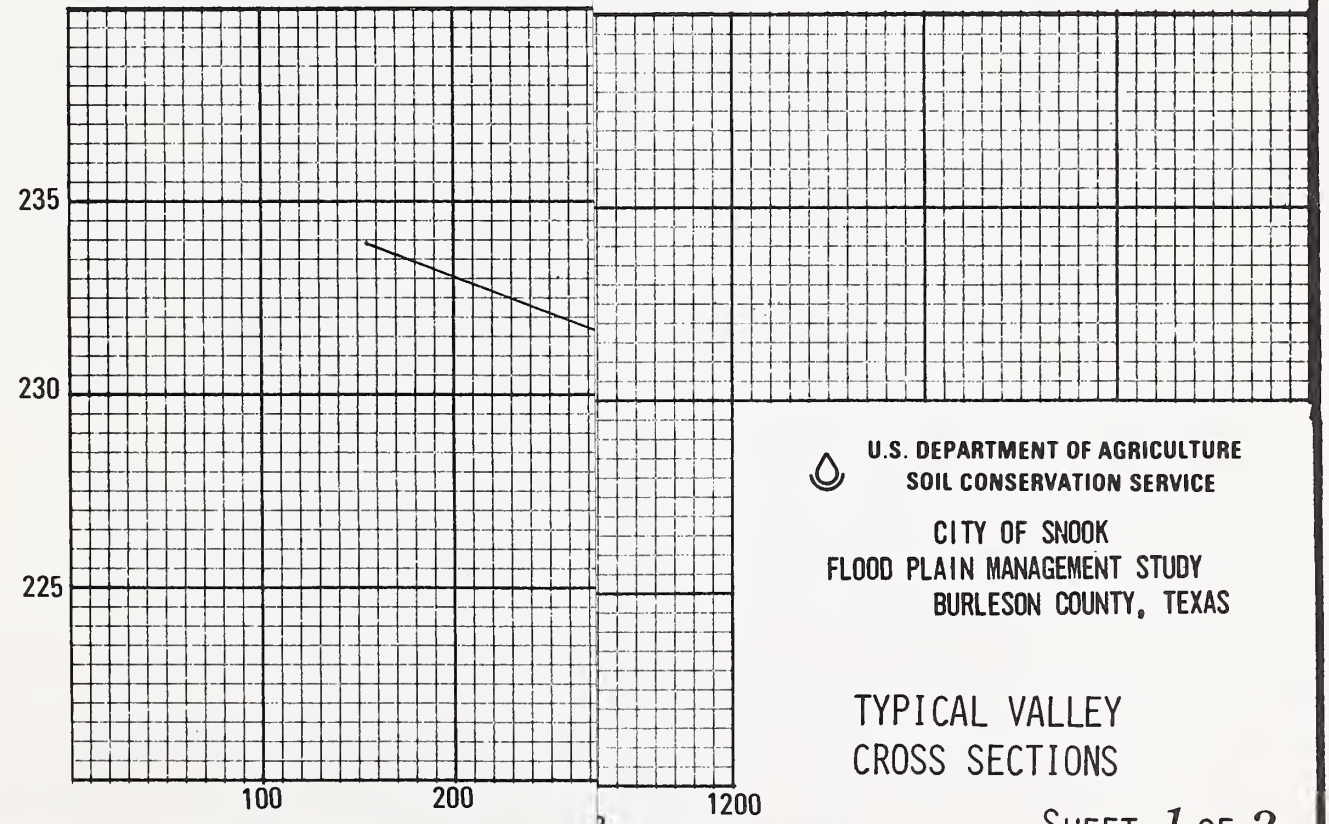

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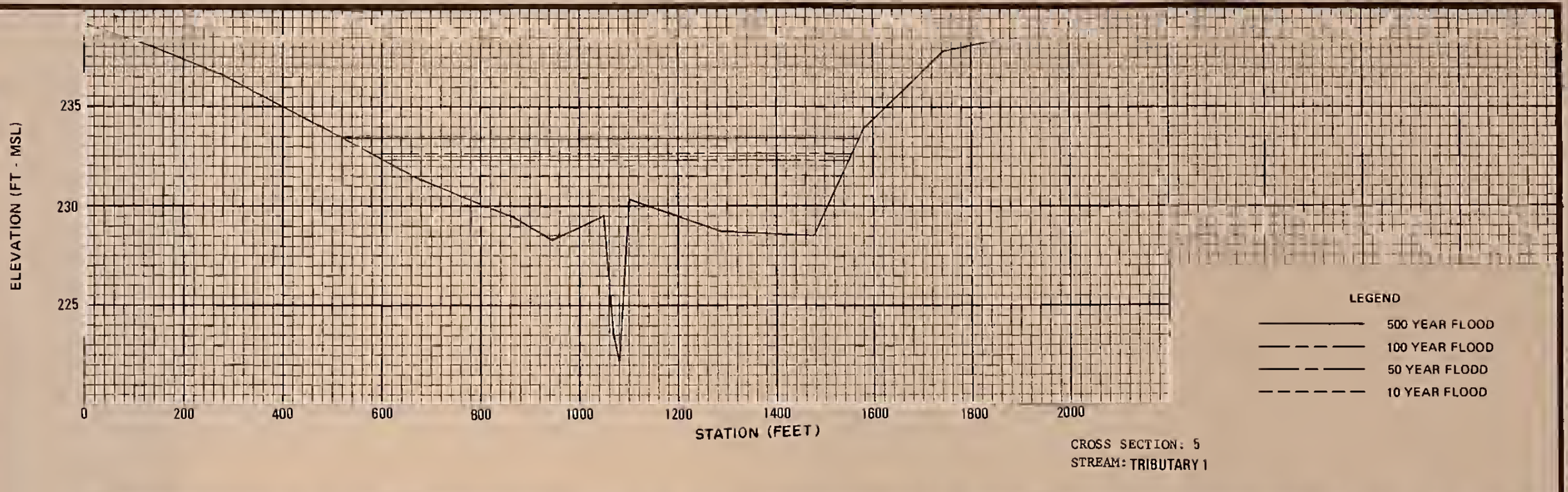
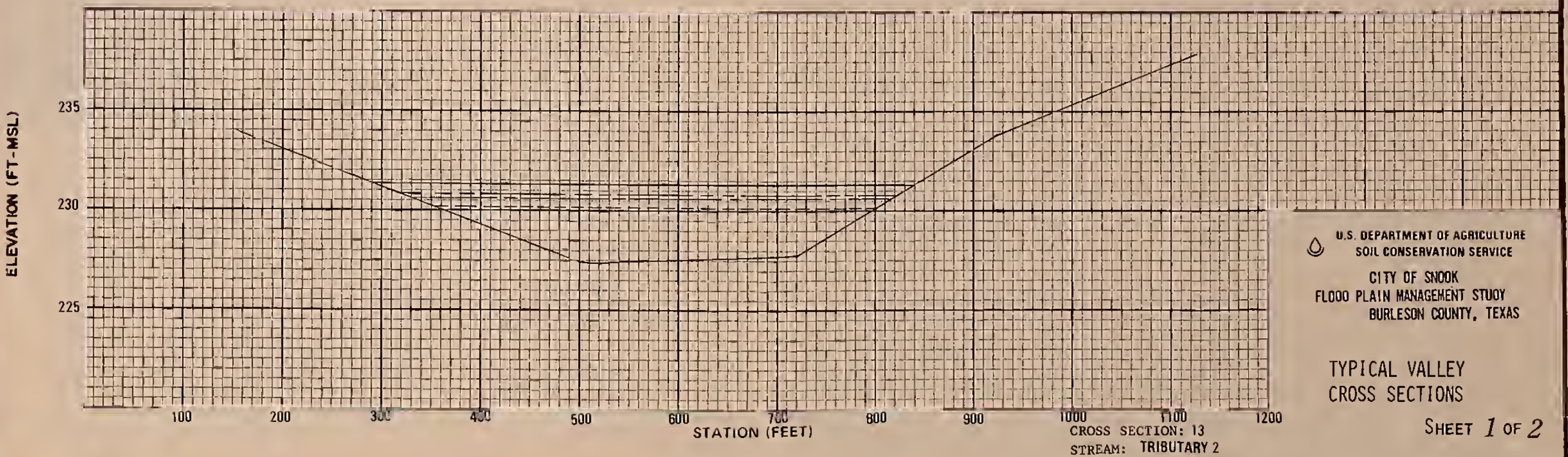
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

TYPICAL VALLEY
CROSS SECTIONS

SHEET 1 OF 2



CROSS SECTION: 5
STREAM: TRIBUTARY 1



CROSS SECTION: 13
STREAM: TRIBUTARY 2

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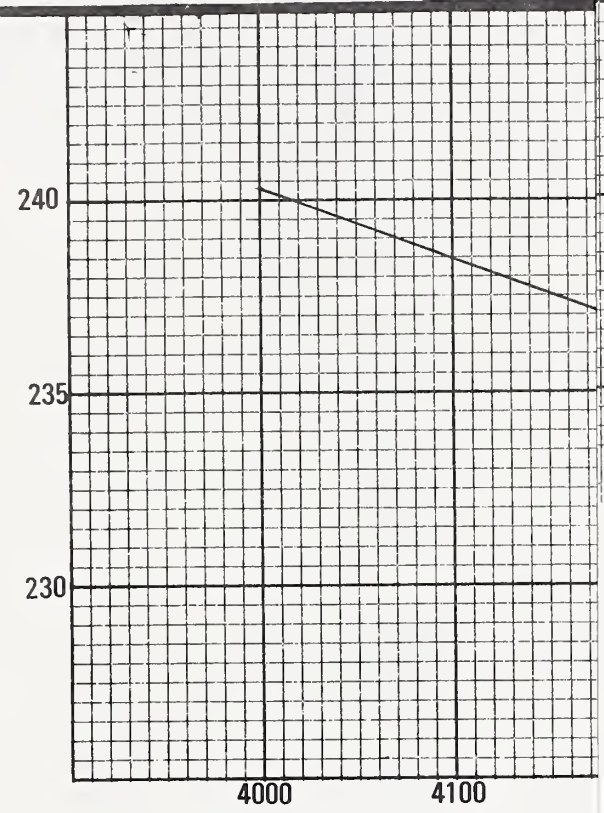
SOIL CONSERVATION SERVICE

CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

TYPICAL VALLEY
CROSS SECTIONS

SHEET 1 OF 2



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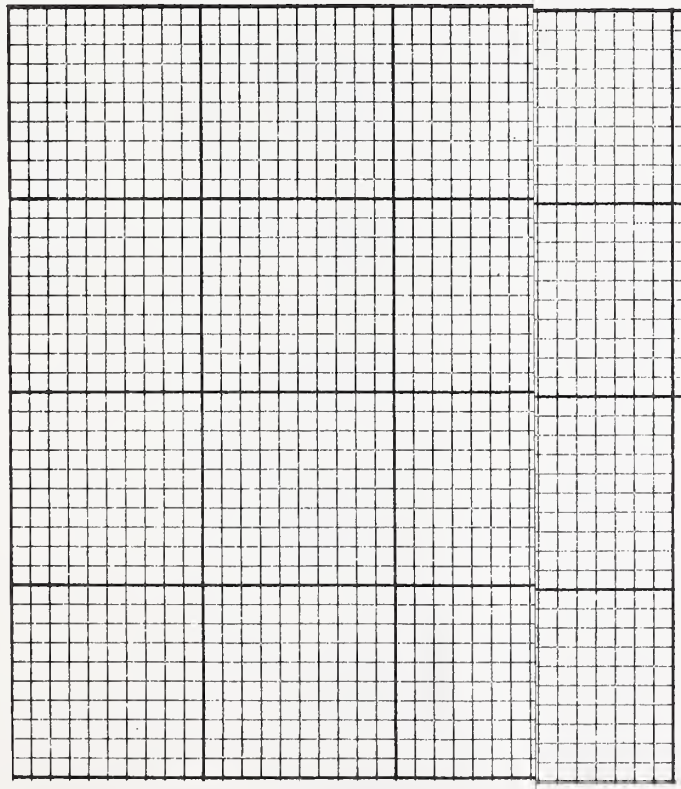
/ 3



LEGEND

500 YEAR FLOOD

100 YEAR FLOOD

50 YEAR FLOOD

10 YEAR FLOOD

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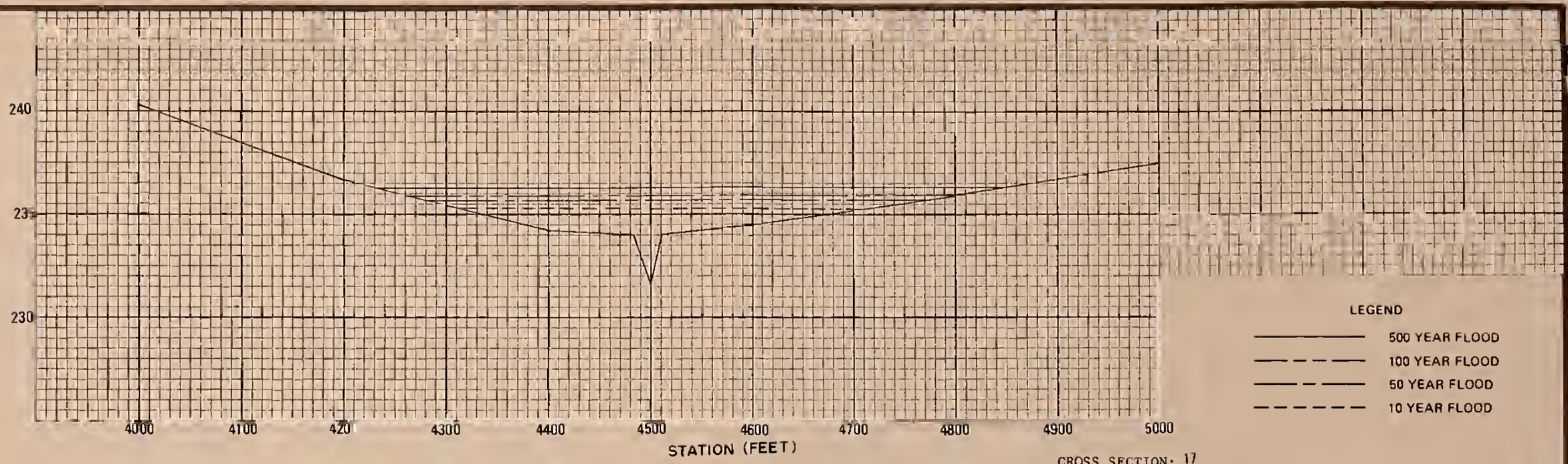
CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

TYPICAL VALLEY
CROSS SECTIONS

SHEET 2 OF 2



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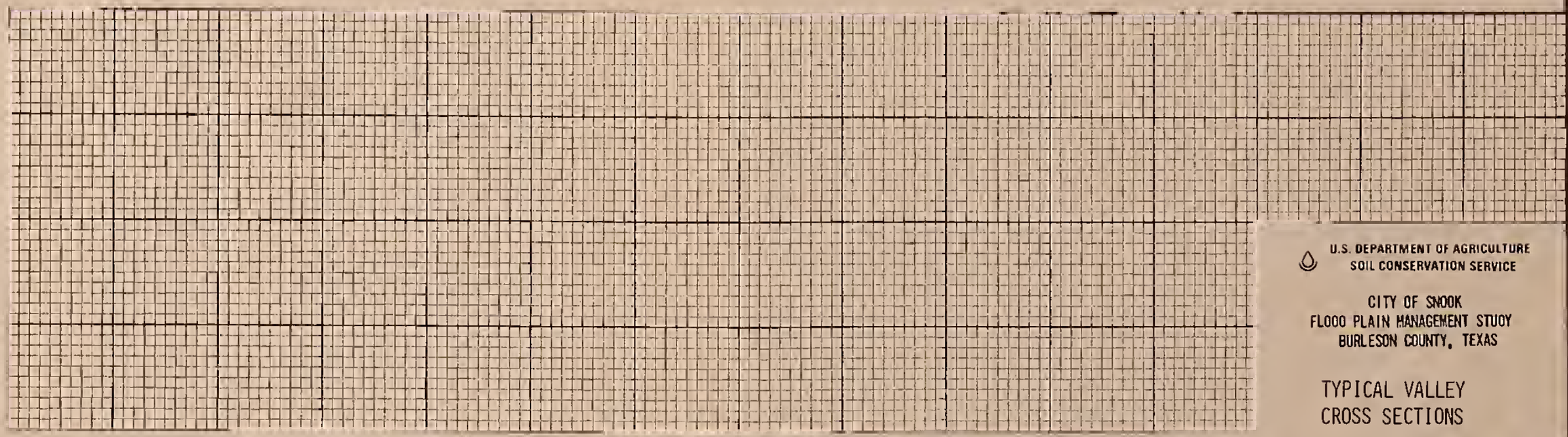
STREAM: TRIBUTARY 3



CROSS SECTION.
STREAM:

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CITY OF SNOOK
FLOOD PLAIN MANAGEMENT STUDY
BURLESON COUNTY, TEXAS

TYPICAL VALLEY
CROSS SECTIONS

SHEET 2 OF 2

TABLE 2

CITY OF SNOOK FLOOD PLAIN MANAGEMENT STUDY

ELEVATION AND DISCHARGE TABULATIONS

	PRESENT CONDITIONS											
	10-YEAR FREQUENCY			50-YEAR FREQUENCY			100-YEAR FREQUENCY			500-YEAR FREQUENCY		
CROSS SECTION NUMBER	DISCHARGE CFS	ELEVATION M.S.L. FEET	FLOOD PLAIN WIDTH FEET	DISCHARGE CFS	ELEVATION M.S.L. FEET	FLOOD PLAIN WIDTH FEET	DISCHARGE CFS	ELEVATION M.S.L. FEET	FLOOD PLAIN WIDTH FEET	DISCHARGE CFS	ELEVATION M.S.L. FEET	FLOOD PLAIN WIDTH FEET
OLD RIVER TRIBUTARY 1												
1	2,291	224.7	645	3,854	225.6	698	4,594	225.9	716	6,317	226.7	762
2	2,164	228.7	603	3,633	229.8	675	4,328	230.2	701	5,945	231.0	753*
3	2,164	230.1	1,025	3,633	230.6	2,140	4,328	230.8	2,265	5,945	231.3	2,426
4	2,153	230.4	813	3,613	231.0	859	4,304	231.2	875	5,911	231.8	932
5	2,091	231.5	867	3,506	232.3	944	4,175	232.6	973	5,733	233.4	1,050
6	2,039	232.3	1,064	3,416	233.1	1,249	4,067	233.4	1,287	5,582	234.2	1,387
7	2,039	233.4	696	3,416	233.9	953	4,067	234.1	1,036	5,582	234.7	1,262*
8	2,039	233.4	1,310	3,416	233.9	1,452	4,067	234.1	1,505	5,582	234.7	1,657
9	1,867	237.2	451	3,123	237.9	559	3,714	238.3	620	5,093	239.0	700
10	1,771	242.3	1,002	2,966	243.0	1,202	3,528	243.4	1,273	4,839	244.0	1,346*
11	1,656	245.2	898	2,767	246.0	1,115	3,290	246.3	1,219	4,507	246.9	1,477*

* Indicates island flow in the flood plain.

TABLE 2

CITY OF SNOOK FLOOD PLAIN MANAGEMENT STUDY

ELEVATION AND DISCHARGE TABULATIONS

	PRESENT CONDITIONS											
	10-YEAR FREQUENCY			50-YEAR FREQUENCY			100-YEAR FREQUENCY			500-YEAR FREQUENCY		
CROSS SECTION NUMBER	DISCHARGE CFS	ELEVATION M.S.L. FEET	FLOOD PLAIN WIDTH FEET	DISCHARGE CFS	ELEVATION M.S.L. FEET	FLOOD PLAIN WIDTH FEET	DISCHARGE CFS	ELEVATION M.S.L. FEET	FLOOD PLAIN WIDTH FEET	DISCHARGE CFS	ELEVATION M.S.L. FEET	FLOOD PLAIN WIDTH FEET
OLD RIVER TRIBUTARY 2												
12	468	226.7	1,876	730	227.5	1,900	848	227.9	1,914	1,133	228.7	1,938
13	468	230.1	445	730	230.6	490	848	230.8	508	1,133	231.3	550
14	334	236.0	72	512	236.5	100	592	236.7	114	786	237.1	140
15	210	243.7	289	313	243.9	316	359	244.0	328	472	244.1	341
OLD RIVER TRIBUTARY 3												
16	496	233.9	1,206	767	234.5	1,323	889	234.7	1,342	1,185	235.4	1,406
17	457	235.3	406	702	235.7	496	812	235.9	542	1,080	236.3	625
18	425	236.7	458	652	237.1	527	754	237.3	552	1,003	237.6	589*
19	385	237.8	236	589	238.3	340	680	238.5	385	903	238.8	452
20	331	238.7	178	504	239.2	317	580	239.4	365	769	239.7	764*
21	240	240.2	445	360	240.5	546	414	240.6	580	546	240.8	684

* Indicates island flow in the flood plain

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

CITY OF SNOOK

BURLESON COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
1	1.2	234.45	Approximately 1.01 miles southeast along FM Road 2155 from junction with State Highway 60, 50 feet northeast of FM Road 2155, in power pole, a railroad spike.
1	1.3	239.90	Approximately 1.74 miles southeast along FM Road 2155 from its junction with State Highway 60, 51 feet southeast of the gravel road centerline, 57 feet southwest of FM Road 2155 centerline, in power pole, a railroad spike.
2	1.3	239.90	Approximately 1.74 miles southeast along FM Road 2155 from its junction with State Highway 60, 51 feet southeast of the gravel road centerline, 57 feet southwest of FM Road 2155 centerline, in power pole, a railroad spike.
2	1.4	248.33	At the junction of FM Road 2155 and County Road 272, 48 feet southwest of FM Road 2155 centerline, 30 feet northwest of County Road 272 centerline, in power pole, a railroad spike.

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

CITY OF SNOOK

BURLESON COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
3	1.10	244.07	At the junction of State Highway 60 and FM Road 2155, 113 feet southeast of State Highway 60 centerline, 55 feet southwest of FM Road 2155 centerline, an "X" cut in the fire hydrant bolt.
3	1.11	242.03	Approximately 0.30 mile southeast along FM Road 2155 from the junction with State Highway 60, 49 feet northeast of FM Road 2155 centerline, in power pole, a railroad spike.
3	1.12	242.60	About 1.17 miles northeast and southeast along County Road 268 from its junction with FM Road 2155, 28 feet southwest of the road centerline, 47 feet northwest of the driveway, in telephone pole, a railroad spike.
3	1.13	236.73	Approximately 0.90 mile northeast and southeast along County Road 268 from its junction with FM Road 2155, 22 feet southwest of County Road 268 centerline, in telephone pole, a railroad spike.

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

CITY OF SNOOK

BURLESON, COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
4	4 JVC	241.742	About 0.53 mile southeast along FM Road 2155 from its junction with State High 60, 60 feet north of southeast corner of the Snook school building, 82 feet southeast of northwest corner, 57 feet southwest of FM Road 2155 centerline, USGS monument stamped "US Geological Survey 242 1960."
4	1.1	242.30	At the intersection of FM Road 2155 and FM Road Loop 2155, 53 feet southwest of FM Road 2155 centerline, 51 feet southeast of FM Road Loop 2155, an "X" cut in the fire hydrant bolt.
4	1.2	234.45	Approximately 1.01 miles southeast along FM Road 2155 from junction with State Highway 60, 50 feet northeast of FM Road 2155, in power pole, a railroad spike.
4	1.11	242.03	Approximately 0.30 mile southeast along FM Road 2155 from the junction with State Highway 60, 49 feet northeast of FM Road 2155 centerline, in power pole, a railroad spike.
5	1.5	242.38	About 0.56 mile southeast along County Road 269 from its junction with FM Road Loop 2155, 24 feet northwest of the dirt road centerline, 34 feet southwest of County Road 269 centerline, in telephone pole, a railroad spike.

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

CITY OF SNOOK

BURLESON COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
5	1.6	245.27	Approximately 1.03 miles southeast along County Road 269 from its junction with FM Road Loop 2155, 48 feet northeast of County Road 269 centerline, 61 feet northwest of northwest building corner, in power pole, a railroad spike.
6	1.6	245.27	Approximately 1.03 miles southeast along County Road 269 from its junction with FM Road Loop 2155, 48 feet northeast of County Road 269 centerline, 61 feet northwest of northwest building corner, in power pole, a railroad spike.
6	1.7	248.04	At junction of County Road 269 and County Road 270, 48 feet northeast of County Road 269 centerline, 46 feet northwest of County Road 270 centerline, in power pole, a railroad spike.